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ABSTRACT

This newsletter contains items of interest to anyone concerned with science and society interactions. The first section consists of various news items and communications that range from announcements of scheduled seminars, workshops and conferences to brief descriptions of conference proceedings, current research work, and discussions relative to the social issues concerning science. This issue contains 27 such news items. This issue also contains two feature articles: (1) Meeting Reports on the XVth International Congress of the History of Science: Notes and Commentaries; and (2) Sociobiology: The New Synthesis. The first article consists of a summary and critical evaluation of the proceedings of the XVth International Congress of the History of Science as observed by three attendees. The second article is an in-depth investigation of the new area of science - sociobiology. A general bibliography is included. (MR)

NEWSLETTER
ON

SCIENCE, TECHNOLOGY, & HUMAN VALUES

October 1977
Number 21

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A few copies of earlier issues are still available.

NEWSLETTER ON SCIENCE, TECHNOLOGY & HUMAN VALUES

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COMPLIMENTARY ISSUE

Please accept this complimentary issue of the Newsletter. Subscription information will be contained in the January issue.

I. NEWS ITEMS AND COMMUNICATIONS

A. Public Forum on Recombinant DNA Research: November 10-12, 1977

Bloomington, Indiana, will be the site for an open conference on the social, ethical, legal, and policy implications of recombinant DNA and other controversial scientific research, November 10-12, 1977. The conference, jointly sponsored by the City of Bloomington and the Poynter Center on American Institutions (Indiana University), will feature participants from academia, industry, government and the private sector. A pre-conference session on Monday evening, November 7, "Human Society and Environmental Diseases," will address topics of particular concern to residents of Southern Indiana, who have been recently embroiled in controversy over PCB contamination of local water supplies and farm lands. Major sessions and presentations include:

Monday, November 7 "Human Society and Environmental Diseases." Speakers: James Marks (Ohio Department of Health) and William H. McNeill (Professor of History, University of Chicago).

Thursday, November 10 [evening] "The Promise and Peril of Genetic Engineering." Speakers: Walter Gilbert (Professor of Molecular Biology, Harvard University) "The Promise of Recombinant DNA Research;" Frank Putnam (Distinguished Professor of Molecular Biology and Professor of Zoology, Indiana University), "Recombinant DNA: Issues and Consequences;" and Liebe F. Cavalieri (Sloan-Kettering Institute, and Professor of Biochemistry, Cornell University), "Recombinant DNA as a Technology: Societal Implications."

Friday, November 11 [morning] "Regulation of Hazardous Research: Constitutionality, Liability and Insurability." Speakers: Patrick Baude (Professor of Law, Indiana University), "Governmental Power to Regulate DNA Research;" Roger Dworkin (Professor of Law, Indiana University), "Legal Institutions and Recombinant DNA Research;" and William R. Miller (Vice-President, American States Insurance Co.), "The Legal Liability of Recombinant DNA Research: Is It Insurable?"

Friday, November 11 [afternoon] "The Search for an Equitable Science Policy." Speakers: Burke Zimmerman (Staff, House Subcommittee on Health and the Environment), "The Right of Free Inquiry: Should the Government Impose Limits?"; Sheldon Krimsky (Program in Urban, Social and Environmental Policy, Tufts University, and member, Cambridge Experimentation Review Board), "Paradigms and Politics: The Roots of Conflict Over Recombinant DNA Research;" and Judith Randal (Science Correspondent, New York Daily News), "Recombinant DNA Research: Perspectives of a Science Journalist."

Friday, November 11 [evening] "The Public Interest: Corporate and Citizen Viewpoints." Speakers: Roland F. Beers, Jr. (Vice-President for Research Affairs, Miles Laboratories), "Potential of Recombinant DNA Technology in Industrial Processes;" and Francine R. Simring (Committee for Genetics, Friends of the Earth, and Coordinator, Coalition for

Responsible Genetic Research) "Quo Vadis? A Public Interest Point of View."

Saturday, November 12 [morning] "The Social and Ethical Implications of Recombinant DNA Research." Speakers: William F. May (Professor of Religious Studies, Indiana University), "The Right to Know and The Right to Create;" and Stephen P. Stitch (Professor of Philosophy, University of Michigan), "Natural Barriers and Forbidden Knowledge."

There is no registration fee for the conference. Local accomodations arrangements may be made directly through The Indiana Memorial Union, Indiana University, (812)337-2536. Conference Coordinator is Professor Robert P. Bareikis; for further information, contact The Poynter Center, 410 North Park Street, Bloomington, Indiana 47401. (812)337-0261.

B. Statement on Scientific Freedom by ACM Policy Committee

The Committee on Computers and Public Policy of the Association for Computing Machinery (ACM) has published the following statement on scientific freedom for comment by ACM members (condensed from the report published in the Communications of the ACM):

Argument

No human endeavor transcends national boundaries so completely, regularly, and obviously as science. It is an international activity par excellence. All scientific workers are continually in debt to their colleagues in other countries; in no area of science is any single country self-sufficient. It follows that all scientists must be sensitive to and supportive of scientific freedom throughout the world. Such scientific freedom involves the ability of all scientific workers to

-- carry on their work free from political interference;

-- communicate freely with colleagues everywhere about all aspects of their work not directly connected to national or commercial security;

-- travel freely within and outside of their own countries to scientific conferences and other meetings given only the availability of funds for such travel.

While individual activity in support of scientific freedom should be encouraged and applauded, the effectiveness of individual endeavors cannot be as great as that undertaken by bona fide scientific organizations because of their greater resources and their ability to represent coherently large numbers of scientists. Moreover, while individual actions may be most appropriate when focusing on the humanitarian aspects of denials of scientific freedom, scientific organizations can more appropriately focus on professional aspects of scientific freedom such as those listed above. And since these professional aspects of scientific freedom lie at the heart of successful scientific endeavor, they must be addressed even though inevitably they involve scientists in issues with political components. Preeminent among scientific organizations which can consider action in these areas are

the national and international scientific societies.

Appropriate Actions

National scientific societies may engage in a variety of activities at various levels of passivity and agressiveness in the support of scientific freedom. Among these are:

1) Setting up mechanisms by which they will become aware of violations of scientific freedom and by giving full publicity to all such violations which are uncovered.

2) Establishing policies to give aid to scientists in the discipline who are deprived of scientific freedom; such policies could encompass, for example, writing letters to appropriate officials in the country in question and arranging invitations for such scientists to visit or emigrate to the United States.

3) Establishing policies which prevent support or cooperation by the organization with scientific conferences, meetings, etc., in countries with demonstrated and uncorrected examples of violations of scientific freedom or in countries which will not give appropriate guarantees that such violations will not occur.

4) Individually and in concert with other scientific societies applying pressure on their own government to support in every way possible activities of the society in the furtherance of scientific freedom.

Discussion

Some unequivocal supporters of scientific freedom nevertheless oppose activities of the sort described above for a variety of reasons. Among these -- and responses to them -- are:

1) Such activities are more appropriately individual actions rather than those of scientific societies. This has been dealt with in the Argument.

2) Such activities involve interference in the domestic affairs of other countries. We suppose they do. But when such interference involves individual human rights rather than, for example, national customs or laws or policies more generally, then the fact that we live on the same globe, that no man is an island, that we, therefore, have obligations to all our fellow men, should transcend such considerations. In addition, it might be noted that many policies which restrict scientific freedom are in violation of the Helsinki argreements.

3) Such activities may be at variance with the foreign policy aims of one's own government. At least as far as the United States is concerned, no foreign policy can be true to the ideals of this country which ignores human suffering as the price of friendly relations; nor can any such

foreign policy be in the long run effective in the pursuit of "higher" goals.

4) Such activities will be ineffective and will divert energies from activities more central to the business of the society. Ineffectiveness is possible but one cannot know without trying. Evidence up to this point is not conclusive on either side. Moreover, to refuse to devote some energies to issues of this kind is to ignore the truth that all branches of science are today inextricably intertwined with national and international affairs.

[Condensed from Communications of the ACM 20, August, 1977: 615-616.]

C. Science Writing Discussed by Journalism Association

Science communication programs and courses in American colleges and universities are increasing in number and variety, but the field is currently beset with a wide range of problems related to recent changes in both science and journalism. Few of the standard texts in the field, for example, address modern methods of science communication; there is polite disagreement over the boundaries and definition of the field; and at present no formal agency exists for communication between fellow teachers and researchers. Some ideas for remedying this situation were discussed at a special session on science communication held August 21, 1977, at the Association for Education in Journalism (AEJ) annual meeting in Madison, Wisconsin. The session (organized by Sharon Friedman [Lehigh] and Rae Goodell [M.I.T]) and subsequent discussions at the AEJ meeting demonstrated a high level of energy and activity in a field that has been booming in the media since the 1960's. For example, the percentage of newspapers in 21 American cities reporting that they had science writers on their staffs increased from about 13% in 1962, to 74% in 1967 and 76% in 1977, despite the fact that in the same period the number of papers in those cities declined.[1] Yet this continued demand is only recently being met with new efforts in the journalism schools. A 1975 survey[2] of U.S. schools of journalism, sponsored by the National Science Foundation and the Council of American Science Writers (CASW), found that some 35 schools had programs or courses in science writing; 25 of these had been developed before 1970. Many journalism schools, however, are experiencing a revival of interest and enthusiasm in the subject and have begun to revamp their courses and programs in response to requests from the scientific community and to increasingly interesting and "newsworthy" issues involving the interaction of science and the public. Preliminary results of a more recent survey[3] conducted by Friedman, Goodell, and Lawrence Verbit (SUNY-Binghamton) indicate renewed activity by scientists and engineers; one-third of the schools reporting in the survey offered science communication programs within S&E departments. One participant at the AEJ session reacted to this finding by speculating that scientists may be pushing for more science communication because they are beginning to believe that "if the story is to be told we should tell it ourselves."

It may not be so clear, however, exactly how to teach someone to tell this story. Session participants recited a familiar litany of the problems of teaching writing to science majors -- their entrenchment in technical jargon and style, their difficulty in grasping the audience level, and the common attitude that communicating science is somehow a lesser activity than doing it, an activity best relegated to the science "drop-out". On the other hand, journalism majors are often either "scared as hell of science" or out to play Woodward and Bernstein in the research labs. Unfortunately, such students frequently know little about the nature of science and the scientific process, and instead focus on current science-related public issues, often without fully understanding the context within which these issues arise. Journalism schools will usually require courses in political science or government for students intending to become political reporters; yet few journalism schools offer or require companion courses on science and public policy for students interested in careers in science journalism.

Moreover, science is still too often segregated as a separate topic in the journalism curriculum, rather than routinely integrated into the general or public-affairs reporting classes as a regular "beat" (this method has, for example, been successfully used in journalism classes at Stanford University). Emphasis in the programs remains largely on print journalism, predominantly newspapers, despite the NSF-CASW report that graduates are most often placed in public information jobs, in specialty publications, and as general-assignment newspaper reporters -- in that order. One teacher remarked that "we'd like to teach about science on television but most of us don't know anything about it." Many of the teachers chorused the question -- is my job to teach writing or science?

In the discussions centering on the criteria for including programs in a Science Communication Directory, it was soon apparent that the field is neither so uniform nor so well-defined as one might assume. Agricultural journalism was singled out as a case in point. Along with the endowment of the land-grant colleges in the 19th century and the committment of the USDA to agricultural research, many courses (and, later, programs) were developed which emphasized both public and in-field communication of agricultural information. Iowa State University, for example, first offered a course in agricultural journalism in 1905. As agriculture in the United States diversified and grew in economic strength and technological sophistication, so too did the "ag" journalists. Today a typical graduate of one of these programs is as likely to write about rural health problems or the effects of pesticides on the environment as about hog breeding or feeding. Yet agricultural journalism has often been considered to be something different from science journalism. Similar problems of territorial definition apply to the fields of health/medical writing and home economics/nutrition writing. Such diversity of interest may compound the problems of compilers of surveys or directories, but interaction at the AEJ session indicates that, however sharply these journalists may define their territory, they share many common problems, interests and needs in research, teaching and practice of their trade.

There were two promising results of the AEJ discussions: 1) steps are being taken to publish a science communication newsletter (interested contributors, participants, or consumers should write Professor Joye Patterson, School of Journalism, University of Missouri, Columbia, Missouri 65201); and 2) some effort is being made to sponsor a special workshop on science communication teaching and research at a future meeting of a journalism or science association. Both these possibilities indicate a revival of interest in the field by journalism educators who have begun noticing the strong science component in many important public issues; we can only hope that they will be met by cooperation and encouragement from scientists, so that in the future neither group will have to tell the story by itself.-MCL

NOTES

1. Data from Editor and Publisher Directory, as compiled by Joye Patterson, University of Missouri, for the NSF-CASW survey report.

2. Joye Patterson, report at the session on science writing, Annual Meeting, Association for Education in Journalism, 21 August 1977, Madison, Wisconsin.

3. Results of this survey will be published as a "Directory of Science Communication Courses and Programs" [forthcoming].

D. Project on Philosophy and Engineering Ethics

In an attempt to broaden the discussion of the problems of engineering ethics, a three-year National Project on Philosophy and Engineering Ethics, administered by the Center for the Study of the Human Dimensions of Science and Technology at Rensselaer Polytechnic Institute will bring together engineers and philosophers to explore and assess the possible contributions philosophers might make in the area of engineering ethics.

The Project will recruit fifteen to eighteen practicing engineers, from both the academic and non-academic engineering communities, and an equal number of philosophers, who will develop, implement and evaluate team projects, meeting in special two-week institutes during Summer 1978. Each philosopher/engineer pair will then work out the details of their projects during the 1978/79 academic year, and the participants will reconvene for a 5-day workshop in the summer of 1979 to critique project plans. After projects are carried out during the 1979-80 academic year, a final 1-week workshop will be held in Summer 1980, at which time each team will report on the results of its project. The project is directed by Robert J. Baum, Director of the Center for the Study of the Human Dimensions of Science and Technology and Associate Professor of Philosophy, Rensselaer Polytechnic Institute, and is funded by the National Endowment for the Humanities. Interested persons should write to Dr. Baum at the National Project on Philosophy and Engineering Ethics, Human Dimensions Center, Rensselaer Polytechnic Institute, Troy, New York 12181 [(518)270-6574]. Deadline for receipt of applications is January 15, 1978; announcement of participant selections will be made by February 15, 1978.

E. Chautauqua Courses on Ethics, Policy, History and Sociology of Science

In a cooperative enterprise with the National Science Foundation, the American Association for the Advancement of Science (AAAS) administers a year-long series of short courses for college teachers. Spaces available are specific to each course or location; deadlines are usually 4 weeks prior to the beginning of a course. For the convenience of our readers, we are listing a few of the interdisciplinary courses (with director, dates and regional location) that might be of interest:

Western Circuit

(W-1) "Thermodynamics, Art, Poetry, and the Environment", Henry Bent - 6-7 March 1978 (Texas), 9-10 March 1978 (California);
(W-7) "Perspectives in Bio-Ethics", Hans W. Uffelmann - 7-8 November 1977 (Texas), 10-11 November 1977 (Colorado), 6-7 March 1978 (Colorado), 9-10 March 1978 (Texas);
(W-10) "The Politics of Government Budgeting", Allen Schick - 14-15 November 1977 (Texas), 13-14 March 1978 (Texas);
(W-11) "Research and Development Decisions and Public Policy", Willis Shapley - 31 October - 1 November 1977 (Oregon), 3-4 November 1977 (California), 6-7 March 1978 (Oregon), 9-10 March 1978 (California);

Central Circuit

(C-4) "Recombinant DNA: Social and Scientific Perspectives", Elizabeth Kutter and LeRoy Walters - 3-4 November 1977 (Michigan), 7-8 November 1977 (Missouri), 10-11 November 1977 (Tennessee), 23-24 March 1978 (Missouri), 27-28 March 1978 (Tennessee), 30-31 March 1978 (Michigan);
(C-10) "The Politics of Government Budgeting", Allen Schick - 20-21 February 1978 (Tennessee);

Eastern Circuit

(E-7) "Genetics and Society: A Dynamic Interaction", Robert F. Murray, Jr. - 14-15 November 1977 (Massachusetts), 21-22 November 1977 (Maryland), 20-21 March 1978 (Maryland), 27-28 March 1978 (Massachusetts);
(E-11) "Ethical Issues in Death and Dying", Thomas Beauchamp - 3-4 November 1977 (Massachusetts), 21-22 November 1977 (Pennsylvania), 27-28 February 1978 (Massachusetts), 16-17 March 1978 (Maryland), 27-28 March 1978 (Pennsylvania);
(E-12) "Scientific Sexism: An Exploration in the Sociology of Science", Ruth Hubbard - 23-24 February 1978 (Massachusetts), 27-28 February 1978 (Georgia);
(E-13) "History of Physical Science since Newton", Stephen Brush - 31 October - 1 November 1977 (Maryland), 10-11 November 1977 (Pennsylvania), 14-15 November 1977 (Connecticut), 21-22 November 1977 (Georgia), 2-3 March 1978 (Maryland), 6-7 March 1978 (Pennsylvania), 23-24 March 1978 (Georgia), 30-31 March 1978 (Connecticut);
(E-15) "Social Indicators", Dennis F. Johnston - 17-18 November 1977 (Pennsylvania), 21-22 November 1977 (Connecticut), 16-17 March 1978 (Pennsylvania), 27-28 March 1978 (Connecticut).

For complete information on all the available courses (which include also many discipline-oriented courses) and application forms, write to the Office of Science Education, AAAS, 1776 Massachusetts Avenue, N.W., Washington, D.C. 20036 for the "Announcement of NSF Chautauqua-Type Short Courses for College Teachers, 1977-1978."

F. NSF Awards Public Service Science Residencies and Internships

The National Science Foundation has announced awards of 18 Public Service Science Residencies and 10 Public Service Science Internships to be made under NSF's Science for Citizens program. Public Service Science Residencies and Internships (PSSRI) are intended to encourage experienced scientists, engineers, and S&E students to participate in activities which will help citizens reach informed decisions on science-related policy issues.

Examples of the range of activities included in these PSSRI awards are: in association with the Texas Public Interest Research Group, an intern will examine the social and economic ramifications of alternate approaches to controlling flooding and storm-water pollution in two Houston watersheds, and will undertake a program of public education in this area; two residents will serve as science advisor and science writer for a weekly Virginia newspaper, treating a series of technological issues facing the community and assisting the development of town meetings to discuss these issues; a resident will prepare materials on occupational health and developments in the study of industrial disease for dissemination, through training sessions, meetings, and publications, to union members; an intern will work with the Pacific Science Center to develop an educational display of regional and local power generation systems, consumption trends, and future options, and a telephone switchboard service to provide specific information or direct callers to other information sources.

For further information on this program, see "Public Service Science Residencies and Internships," Newsletter on Science, Technology and Human Values, April 1977, pp. 1-2.

G. EVIST Program Announces 1977 Awards

NSF's Ethics and Values in Science and Technology (EVIST) program has announted its awards for fiscal year 1977:

1. Michael S. Baram, Franklin Pierce Law Center, Concord, New Hampshire 03301; "Ethical Issues in Regulation and Risk Management: A Study of Federal Science-Related Agencies."

Objectives: To identify the ethical and legal issues in the use of cost-benefit, risk-benefit and other "rational" decision making techniques to manage scientific and technological developments associated with uncertain costs, risks and benefits to individuals and to society.

2. Paul R. Brass, University of Washington, Seattle, Washington, 98195; "Value Issues in Technological Innovation and Social Choice: A Case Study of United States Rice Production Technologies in South Asia."

Objectives: To explore and analyze some of the value assumptions and implications surrounding the transfer of innovative rice research and production techniques from the United States to South Asia.

3. E. Ray Canterbery, Department of Economics, Florida State University, Tallahassee, Florida 32306; "A Study of the Impact of Values on Economic Research and Policy Analysis."

Objectives: To identify and analyze the processes by which values become involved in economic science, and the factors associated with divergent values among different schools of economics, in relation to the development of national economic policy.

4. Kan Chen, Department of Electrical Engineering and Computer Sciences, University of Michigan, Ann Arbor, Michigan 48109; "A Study of Value-Oriented Social Decision Analysis."

Objectives: To develop a procedure, based on formal social decision theory, to describe the value contexts in which different, contending groups perceive particular technologies, and to use those value descriptions to establish communication and effect value trade-offs between the groups.

5. Willard Gaylin, Institute of Society, Ethics and the Life Sciences, 360 Broadway, Hastings-on-Hudson, New York 10706; "The Dynamics of Scientific Research: Studies of Scientific Research on Aggression" (25% support provided by the NEH).

Objectives: To conduct a two-year, interdisciplinary study of three aborted research projects on violent behavior, to determine the political, legal, and ethical dynamics that led to their demise.

6. Samuel Gorovitz, Council for Philosophical Studies, Department of Philosophy, University of Maryland, College Park, Maryland 20742; "Summer Institute on Philosophical Ethics for Science and Engineering Faculty" (80% support provided by the NEH).

Objectives: To organize and conduct a four-week summer institute for faculty members from U.S. science and engineering departments, to enable them to study contemporary problems in moral philosophy as applied to issues in science and technology.

7. Roger E. Kasperson, Geography Department, Clark University, Worcester, Massachusetts 01610; "A Study of Equity Issues in Radioactive Waste Management."

Objectives: To study how equity considerations enter into public decisions regarding technological developments, focusing on radioactive waste

management as a problem which poses unique and significant combinations of ethical issues and technological uncertainties.

8. Allen V. Kneese, Department of Economics, University of New Mexico, Albuquerque, New Mexico 87131; "A Study of the Ethical Foundations of Benefit-Cost Analysis Techniques" (30% support provided by the NEH).

   Objectives: To study the theoretical basis of cost-benefit analysis from an ethical perspective, and thus to clarify methodological and value issues raised when results of benefit-cost analysis are used to evaluate public policies involving uncertain scientific data and risks of large magnitude.

9. Arthur H. Livermore, AAAS, 1776 Massachusetts Avenue, Washington, D.C. 20036; "Resource Directory to Courses and Programs in the Ethical and Human Values Implications of Science and Technology" (supplementary grant).

   Objectives: To prepare an inclusive, updated and indexed Resource Directory to Courses and Programs in the Field of Ethical and Human Value Implications of Science and Technology, which will be disseminated for use in developing and improving courses and programs.

10. Franklin A. Long, American Academy of Arts and Sciences, 165 Allandale Street, Boston, Massachusetts 02130; "International Symposium on Critical Value Issues in Choosing Appropriate Technologies in Developed and Developing Countries."

    Objectives: An international interdisciplinary symposium to be held in Boston in May 1978 to weigh the relative merits of high-technology and low-technology models for the developed and developing nations and consider whether there exists the basis for an "appropriate technology", suitable for global implementation, which would promote balanced development and be in keeping with human and environmental needs.

11. Julia L. Makarushka, The Maxwell School, Syracuse University, Syracuse, New York 13210; "A Pilot Study of Informed Consent and Equitable Compensation" (50% support provided by the NEH).

    Objectives: To conduct a pilot study of the ethical and value issues used to determine criteria for equitable compensation for personal injury resulting from biomedical research, and industrial illness and injury.

12. Kenneth M. Sayre, Department of Philosophy, University of Notre Dame, Notre Dame, Indiana 46556; "Values and Electric Power Industry Regulation."

    Objectives: To analyze the value dimensions of decision making by a state agency responsible for electric power regulation, namely, the Illinois Commerce Commission (ICC).

13. Bert E. Swanson, Institute on Man and Science, Rensselaerville, New York 12147; "Ethical Problems Confronting Scientists and Engineers as Community Development Experts: An Exploratory Workshop."

Objectives: To conduct a workshop which will explore ethical problems that confront scientists and engineers retained by local governments to assist in planning, implementing and evaluating community development programs.

14. Charles Weiner, School of Humanities and Social Sciences, MIT, Cambridge, Massachusetts 02139; "Social Impacts of the Recombinant DNA Controversy -- Documentation of the Responses of the Scientific Community, Government and the Public" (50% support provided by the NEH).

Objectives: To document the value perceptions, motivations, and actions of scientists and others involved in the growing national debate surrounding the recombinant DNA case (Continuance of on-going project).

H. Committee on Scientific Freedom and Responsibility to Sponsor Symposia

The AAAS Committee on Scientific Freedom and Responsibility will sponsor three symposia at the forthcoming AAAS Annual Meeting (February 12-17, 1978) in Washington, D.C. Additional details should be available in late December and will be published in Science magazine and the January issue of the Newsletter. Symposia sessions will include:

1) "Whistle-blowing and Scientific Responsibility: The Management of Technical Dissent," arranged by Rosemary A. Chalk and Frank von Hippel.

Wednesday, February 15, 1978 [morning] "Technical Dissent within the Regulatory Agencies: The Experience in the Food and Drug Administration." Presiding: Harold Green (National Law Center, Georgetown University). Speakers: Carol S. Kennedy (Senior Psychiatric Advisor, Veterans' Administration, and former FDA Psychiatrist), Marc Novitch (Deputy Associate Commissioner of Medical Affairs, FDA), Larry Horowitz (Staff Director, Senate Subcommittee on Health and Scientific Research), Norman Dorsen (Professor of Law, School of Law, New York University). Discussant: Frank von Hippel (Center for Environmental Studies, Princeton University).

Wednesday, February 15 [afternoon] "Technical Dissent within the Regulatory Agencies: The Experience in the Nuclear Regulatory Commission." Presiding: Bentley Glass (SUNY-Stony Brook). Speakers: Ronald M. Fluegge (Medical Physicist, Shoss Radiological Group, Inc., Cape Girardeau, Missouri, and former NRC Reactor Engineer), Roger Mattson (Director, Division of Systems Safety, NRC), Henry R. Myers, (Special Consultant on Nuclear Energy, House Committee on Interior and Insular Affairs), Robert J. Baum (Director, Center for the Study of the Human Dimensions of Science and Technology, RPI). Discussant: Jeremy Stone (Director, FAS).

2) "Regulation of Scientific Inquiry: Societal Concerns with Research," arranged by Hans Mauksch, Rosemary Chalk, and Kurt Wulff. Thursday, February 16 [morning and afternoon sessions].

3) "Human Rights and Scientific Freedom: Are Scientists Special?" arranged by John Edsall and Joel Primack.

Friday, February 17 [morning] Presiding: John Edsall (Professor of Biochemistry Emeritus, Harvard University). Speakers: Robert W. Kates (Professor of Geography, Clark University, and Chairman, NAS Committee on Human Rights), Joel Primack (Associate Professor of Physics, University of California, Santa Cruz), Mark Mellman (Executive Director, Committee of Concerned Scientists, Inc.), Robert F. Drinan (Member, U.S. House of Representatives).

I. Symposium on Teaching the History of Science

The Committee on Undergraduate Education of the History of Science Society will sponsor a symposium at the Society's annual meeting in Dallas, Texas, Thursday, December 29, 1977. The symposium "Strategies of Undergraduate Instruction" should be of special interest to those teaching courses involving the history of biology and medicine or the social aspects of science.

Co-chairpersons and organizers of the symposium are Arthur Donovan (West Virginia University) and Maurice Finocchiaro (University of Nevada at Las Vegas).

Speakers will be: Sheldon J. Kopperl (Grand Valley State Colleges), "Madness or Salvation: A Course on the History of Genetic Recombination;" Stanislaus Dundon (California Polytechnic State University), "The Lure of the Human and Social Dimensions in the History of Science;" Lois Magner (Purdue University), "Magic and Medicine: An Introduction to the History of Medicine;" Nathan Sivin (University of Pennsylvania) will comment on these papers and speak briefly about his course on medicine in China.

Interested persons should contact Stephen G. Brush (Chairman, Committee on Undergraduate Education), Department of History and Institute for Physical Science and Technology, University of Maryland, College Park, Maryland 20742, (301)454-2723.

J. Conference Proceedings: Biomedical Research and the Public

In April 1976, a conference co-sponsored by Case Western Reserve University and the Institute of Society, Ethics and the Life Sciences examined the relationship between biomedical research and the public, in its historical, social, political, legal and ethical contexts. The report on this conference features edited transcripts of the presentations and the panel responses and discussion. Topics range from the roles of Congress, government agencies and scientific organizations, to questions of freedom of scientific inquiry

and mechanisms for public participation and decision making. Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. [Request "Biomedical Research and the Public," May 1977, Prepared for the Subcommittee on Health and Scientific Research, Committee on Human Resources, U.S. Senate].

K. Conference Proceedings: Toxic Substances and Trade Secrecy

The Technical Information Project, a Washington-based non-profit research and education group, has produced a tightly edited, well-designed report on a national workshop on toxic substances trade secrecy held in Coolfront, West Virginia, February 1977. The workshop, supported by the National Science Foundation's EVIST Program, invited representatives from industry, government, academia, science journalism, and the private sector to discuss the problems of communication and the rights and responsibilities of, in particular, 1) citizens, 2) chemical producers, 3) scientists and engineers, and 4) government agencies. The report outlines the specific recommendations of each of the four working groups on rights and responsibilities, but also includes the comments and suggested changes made by members, thus presenting a less monolithic and more realistic report than most such publications.

For further information write the Project Director, Dr. Albert J. Fritsch, Technical Information Project, Inc., 1346 Connecticut Avenue, N.W., Suite 217, Washington, D.C. 20036.

L. Conference Proceedings: Ethics, Professionalism and Maintaining Competence

The Task Committee for the PAC Specialty Conference of the American Society of Civil Engineers (ASCE) has published the papers and addresses from a conference on "Ethics, Professionalism and Maintaining Competence," held March 1977 at Ohio State University. The thirty-two papers touch on professional behavior and current attempts to codify professional ethics in engineering; on professional upgrading and continuing proficiency; and on teaching ethics to engineering students. The report includes reprints of the various ASCE codes and draft codes as appendixes. Available from ASCE, 345 East 47th Street, New York, New York 10017, for $10.00.

M. Periodicals List: From *Science* to *Sanity* to *Small Town*

An extensive list of several hundred "Periodicals that Progressive Scientists Should Know About" was published in June 1977 by the Tallahassee Chapter of Science for the People. The accompanying description stresses that "the fact that a periodical is listed here does not necessarily imply

an endorsement by our group," and the list does contain a diverse (in affiliation, circulation, intent, and cost), international group of publications, with complete addresses and occasional annotations.

For a copy, send "4 self addressed stamped business size envelope or three first class postage stamps" to Tallahassee Science for the People, c/o Progressive Technology Co., P.O. Box 20049, Tallahassee, Florida 32304.

N. Report: Academic Activities in Science, Technology and Society

Science, Technology, and Society: A Survey and Analysis of Academic Activities in the U.S., by Ezra Heitowit, pulls together the results of the extensive survey conducted by Heitowit and his Cornell University colleagues on teaching and research on science, technology, and society (STS). The report assesses the demographic data on course sponsorship and content, summarizes the characteristics of 128 programs, and includes six specific program case studies. More than a report on survey results, the present volume assesses the needs in the field, particularly in the areas of textbooks, increased communication, and faculty development and training.

For more information, contact Professor Ezra Heitowit, Cornell University, Program on Science, Technology and Society, Ithaca, New York 14853.

O. Report: Research Involving Children

Children who are subjects of research will be given special protections under the recommendations of the 11-member National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research. The Commission submitted its Report and Recommendations: Research Involving Children at the end of September to the Secretary of the Department of Health, Education and Welfare (HEW) and to Congress. By law, that report must be considered in the development of HEW regulations governing any research that involves children and that is supported or regulated by the department.

The Commission recommends that the responsibility for ensuring that research projects involving children meet the suggested criteria be vested in the local review board of the institution in which the research will be conducted. The criteria are: that the research should be scientifically sound and significant; that studies should have been conducted on animals, adults or older children before involving infants; that any risks involved should be minimized; that adequate measures should be taken to protect the privacy of subjects and their families, and to maintain the confidentiality of information; and that subjects should be selected fairly.

HEW will publish the full report in the Federal Register and solicit public comments on the recommendations before publishing the proposed regulations. Single copies of the report are available from Betsy Singer, Public Information Officer, National Commission for the Protection of Human Subjects, Room 125, Westwood Building, Bethesda, Maryland 20016, (301)496-7776.

P. NEH 1978 Summer Seminars for College Teachers

The National Endowment for the Humanities will offer approximately 100 eight-week Summer Seminars for College Teachers during the summer of 1978. Seminars will cover the various disciplines of the humanities and humanistic social sciences and will be located at major universities and research centers in all regions of the country.

The purpose of the program is to provide opportunities for faculty members of undergraduate and two-year colleges to work with distinguished scholars in their fields at institutions with library collections suitable for advanced study. Through research, reflection, and discussion with the seminar director and their colleagues in the seminar, participating college teachers will sharpen their understanding of the subjects they teach and improve their ability to convey these understandings to their students. Twelve college teachers will be selected to attend each seminar, and each participant will receive a stipend of $2,000 for a two-month tenure period plus a travel allowance of up to $400.

Specific information concerning seminar topics, directors, and locations will be available upon request in early December. Prospective applicants should write to the Division of Fellowships, National Endowment for the Humanities, 806 15th Street, N.W., Washington, D.C. 20506, or call Mitchell Schneider at (202)724-0377. Application deadline will be March 13, 1978.

Q. Program to Support Publication Costs of Humanities Texts

In order to ensure that research generated by grants from the National Endowment for the Humanities is made broadly available to the scholarly community and an interested public, the Endowment will now consider proposals requesting the subvention of publication costs.

This departure from past Humanities Endowment policy allows both commercial and non-profit presses to apply for assistance towards the publication of major humanities texts when the initial cash-flow is insufficient to allow publication presently to be considered, or where it seems evident that intolerable losses would otherwise be suffered.

Applications are being accepted for the publication of research materials which have resulted directly from Humanities Endowment grants, after such materials have been declared acceptable to a commercial or university press by its normal standards of review. The form of the proposed publication must appear appropriate to the nature of the work and to the anticipated readership.

Establishment of this program by the Endowment demonstrates its growing awareness of the impediments to the publication of scholarly work. If profits are generated by works selected for this program, then the Endowment will

receive reimbursement by some set formula.

A deadline of December 1, 1977 has been established. For further information contact: Publications Program, Division of Research Grants, MS 350, National Endowment for the Humanities, 806 15th Street, N.W., Washington, D.C. 20506, (202)382-5857.

R. New Program: Health and Humanities at Georgetown University

The Georgetown University Medical Center, Washington, D.C., has announced the formation of a Division of Health and Humanities within its Department of Community Medicine. The Head of the new Division, Dr. Warren T. Reich, will be developing a curriculum, including a core of Bioethics courses, for the Schools of Medicine, Dentistry, and Nursing at Georgetown. Additional courses in literature, philosophy, theology, art, history, sociology and law will be aimed toward "the identification of value issues in health care and the biomedical sciences," and the development "of intellectual skills for understanding and resolving the increasing ethical dilemmas raised by the contemporary life sciences, health sciences, and health care." [For more information, see The Kennedy Institute Quarterly Report, Vol. 3, Summer 1977.]

S. Lund Letter on Science, Technology, and Basic Human Needs

At a May 1977 conference at the University of Lund (Sweden) to discuss the upcoming 1979 UN Conference on Science and Technology for Development (UNCSTED), a group of persons from universities and research organizations throughout the world decided to take some specific actions to enhance opportunities for global participation at UNCSTED. The group concluded that one way to increase the chances for success of the conference would be to "open up the debate on the issues underlying UNCSTED to include a wide range of critical views and alternative experiences." It was decided, therefore, to create an informal network, with a small secretariat and an occasional circular letter. The only qualification for participation in this network is "serious interest in exploring alternative approaches to better utilization of science and technology to basic human needs."

The resulting Lund Letter on Science, Technology, and Basic Human Needs (Letter No. 1, July 1977) contains information on UNCSTED preparations, official and non-governmental, as well as recent publications and forthcoming international meetings of interest. Editors are Jan Olsson and Boel Billgren, Research Policy Program, University of Lund, Sölvegatan 8, S-223 62 Lund, Sweden. [North American correspondants may write Ward Morehouse, Suite 1231, 60 East 42nd Street, New York, New York 10017, (212)972-9877.

T. COSTED Newsletter from the International Council of Scientific Unions (ICSU)

This Newsletter, published by The Committee on Science and Technology in Developing Countries (COSTED), aims to disseminate information on science education, the impact of science and technology, and conferences and other communications ventures involving developing countries. The most recent issue (July 1977) contains articles on "Biological Control of Pests in Developing Countries", "Scale and Appropriate Technology", and many other informative reports, including one on the United Nations Conference on Science and Technology for Development.

The newsletter is a primary activity of the Appropriate Technology Information Service (ATIS) started in 1977 by COSTED, a Scientific Committee of ICSU, in an effort to improve dissemination of scientific information among developing countries.

Those interested in obtaining copies may write to Scientific Secretary, COSTED, Indian Institute of Science, Bangalore - 560 012, India.

U. New Curriculum Newsletter on Humanities Perspectives on Technology

The Lehigh University Humanities Perspectives on Technology Program sponsors a newsletter to increase information exchange in the field of technology studies. The first issue of the Curriculum Newsletter on Humanities Perspectives on Technology, published in August, contains articles by John Woodcock (Indiana) and Jack A. DeBellis (Lehigh) on development of their science and literature courses, an annotated bibliography of recent publications, book reviews, and an article by Edward Gallagher (Lehigh) reviewing four educational films on work in a technological society.

The newsletter is supported by a grant from the National Endowment for the Humanities, and is distributed free. Write: Dr. Stephen J. Cutcliffe, Editor, HPT Program, 216 Maginnes Hall #9, Lehigh University, Bethlehem, Pennsylvania 18015.

V. NSF Reports on Employment and Expenditures in Science

The Division of Science Resources Studies at NSF periodically publishes highlights of full reports to be issued later. Two recent issues in this Science Resources Studies Highlights series are:

1) "Private Industry Employment of Scientists and Engineers in 1975 Shows 5-Year Decline" (NSF 77-312). According to this report, employment of scientists and engineers in U.S. private industry decreased 5% from 1970 to 1975, in contrast to a 19% gain 1960-65 and 14% gain 1965-70. Copies are available from the Division of Science Resources Studies, NSF, Washington, D.C. 20550.

2) "Academic R & D Expenditures Up 9 Percent in 1976" (NSF 77-314). Although R & D expenditures at U.S. colleges and universities increased 9% from 1975-76, this increase amounted to only 2% in constant dollar terms. Federal agencies continue to finance two-thirds of all academic R & D. These and other data are available from the Division of Science Resource Studies, NSF, Washington, D.C. 20550.

W. SISCON Series Issued by Butterworths

Since 1973 the Science in a Social Context Project (SISCON) has produced and distributed for testing several hundred copies each of 27 study guides on different topics. The first of these were published in the Butterworths-SISCON Series in March 1977 and more will follow at intervals of about six months.

The first six titles are: Ernest Braun and David Collenridge, Technology and Survival; Kenneth Green and Clive Morphet, Research and Technology as Economic Activities; Leonard Isaacs, Darwin to Double Helix: The Biological Theme in Science Fiction; Keith Pavitt and Michael Worboys, Science and Technology in the Modern Industrial State; Clive Morphet, Galileo and Copernican Astronomy: A Scientific World View Defined; Diana Manning, Society and Food: The Third World.

A booklet describing the publishing program and forthcoming volumes can be obtained from Butterworth Publishers, Inc. (U.S. office: 19 Cummings Park, Woburn, Massachusetts 01801).

X. New Journal on the History of Sociology

The Journal of the History of Sociology is soliciting scholarly articles and reviews of work on the history of sociology, particularly histories of individual sociologists or departments, analyses of the roles of sociologists in corporate and government investigatory, regulatory and policy-making bodies, and sociologists' professional involvement in war efforts or social movements or concerns.

Inquiries about subscriptions and manuscript contributions may be addressed to the Editor, Journal of the History of Sociology, Department of Sociology, University of Massachusetts-Boston, Boston, Massachusetts 02125.

Y. Technology and Society Audio-Visual Resources Digest

A digest describing films and videotapes on science, technology and society has been compiled by Project INPUT (Increasing Public Understanding of Technology) at Penn State, under a grant from the National Science Foundation. The 26-page digest lists the price and other relevant information and a brief description or evaluation of each item.

For further information write Project INPUT, 102 Material Research Laboratory, The Pennsylvania State University, University Park, Pennsylvania 16802.

Z. Research on Women in Science

Deborah Warner, of the Smithsonian Institution's Museum of History and Technology, is assembling a file of current research progress in the area of women in science. The file will be available for use by contributors and convention program chairpersons arranging women's studies sessions. Individuals are invited to send descriptions of their current research on women's topics, as well as references to relevant source materials to: Deborah Warner, Museum of History and Technology, Smithsonian Institution, Washington, D.C. 20560.

AA. Expansion of Graduate Program at University of Denver

The Graduate School of International Studies (GSIS) of the University of Denver has established a multidisciplinary graduate program in Technology, Modernization, and International Studies (TMIS). The program is designed to provide a basic understanding of the analytical approaches to the study of technology and its interactions with national societies and their international relations. Courses emphasize comprehension of economic, sociological, and political analyses of technology, research methodology, plus comprehension of the essentials of the technological design and evaluation processes to enhance professional-level dialogue with trained technologists.

Program development has been supported by the U.S. Office of Education, the IBM Corporation and the Sloan Foundation. Fellowship support and graduate research assistantships are available for qualified students.

For more information on the program, write Joseph S. Szyliowicz, Director, Technology and Modernization Program, Graduate School of International Studies, University of Denver, University Park, Denver, Colorado 80208; (303) 753-2324.

II. LETTER TO THE EDITOR

To the Editor:

I wish to react to the research report submitted by Professor Mark S. Frankel, Newsletter No. 18, pp. 18-19, on "ethics and political science research."...Finding that only three out of sixteen political science associations surveyed showed an interest in developing a code of ethics for research involving human subjects, Professor Frankel concludes that

> political scientists conducting research with human subjects do so without any explicit guidelines for their actions...Yet, without clear delineation of rights and responsibilities within the research setting, accountability remains elusive and all parties to the research process are left floundering in an ethical quagmire. The survey results should present a challenge to the profession to use its resources to promote meaningful and prescriptive discussions of the ethical issues and to formulate guidelines for the conduct of research.

This conclusion raises the following questions in my mind:

1) In political science research, what is a "human subject?"

2) Do "guidelines" only involve the definition of rights for "subjects" and responsibilities for researchers, or is there some reciprocity?

3) Can guidelines eliminate ethical quagmires? Can accountability?

4) Do scientific findings (i.e., the survey results) compel the conclusion that "meaningful and prescriptive discussion" is required?

Political scientists very rarely conduct laboratory-type experiments with human subjects, as do psychologists and some sociologists. When they do, I would agree that procedures safeguarding the subjects from physical or mental harm are indeed required. Normally, however, "human subjects" in political science research are people who receive and are asked to complete questionnaires. Some comply and some do not. The rate of return to a mail questionnaire rarely exceeds 20 percent. Often they are asked to fill out questionnaires, or respond in structured interviews to questionnaires, administered in person by an interviewer. What is to prevent the respondent's showing the interviewer out of the door? Whether anonymity or access to the information is guaranteed or not, the circumstances under which the information is obtained are such as to vest the right of consent in the respondent; the researcher operates entirely at his sufferance. It has been suggested that research utilizing interviews of significant actors, without the use of a questionnaire, also requires informed consent. In 25 years of research experience of this kind I have never encountered a respondent who did not know how to refuse his consent. To consider our respondents as "subjects" strikes me not only as silly but as demeaning to their judgment and intelligence.

It seems to be assumed that guidelines are designed to constrain the researcher. If there is such a thing as a right to do research and a right not to cooperate with research (remember, we are not talking of the insane and the incarcerated), it seems odd that a non-reciprocal set of constraints is even being considered. The mania for guidelines has its origins in medical and genetic research, and in the institutions for regulating abuse of the environment. I am not disputing the salience of restraint in these situations. But I am urging some caution in seeking to generalize the practice to fields of endeavor in which they are not appropriate and in which they violate somebody else's rights.

The notion of "ethical quagmires" in research and the call for greater "accountability" always amuse me. Life is full of ethical quagmires that cannot readily be made traversable by systems of accountability. There is also something called a "personal sense of responsibility." It is a telling commentary on the pervasive ignorance of the history of ideas that calls for climbing out of the quagmire always invoke visions of theological breakthroughs and new ethical imperatives which would get us to high and dry ground. Except in monistic intellectual systems, there simply is no straightforward single ethic. Scholarship and academic freedom, I had always thought, are designed to prevent the imposition of monistic systems by way of imperatives and guidelines. Pluralism of ideas is intrinsic to research. The call for a single ethic is a disguised appeal to have "your" ethic take the place of "mine."

Hence it is difficult to see who is to be accountable to whom. Accountability can exist only when there is an agreed code of conduct designed to safeguard the consumer, patient, client, or victim from defined dangers. In this instance we have no helpless victim and need no agreed code of conduct beyond the normal canons of professional probity. To create a forum for exacting accountability in such a situation comes close to wishing to control research for the sake of controlling. (I repeat: I am talking of typical political science research; I am not arguing that there may not be a need to control other types of research in certain circumstances).

I find that Professor Frankel's research results suggest that there is no need for further meaningful and prescriptive discussion. Thirteen political science associations seem to agree. I congratulate them.

Ernst B. Haas
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Berkeley, California 94720

Commentaries on articles appearing in the Newsletter are welcome. We regret that we cannot publish all letters and reserve the right to abridge as necessary.

III. MEETING REPORTS

Notes on the XVth International Congress of the History of Science

Edinburgh, Scotland, 10-19 August 1977

by William A. Blanpied
National Science Foundation
Washington, D.C. 20550

Theme and Organization

The theme of the XVth International Congress of the History of Science, held in Edinburgh, Scotland, from 10-19 August 1977, had been boldly announced as Human Implications of Scientific Advance: Historial Perspectives. Anyone who went to Edinburgh expecting that the sessions would be organized according to that theme, or even that a significant fraction of the papers presented at the Congress would adhere to it, would have been disappointed. The interests of both professional and amateur historians of science cover far too broad a range, and those within the discipline who advance obvious social significance as a primary criterion for acceptable scholarship are in too decided a minority. Yet many of the 750 participants seemed, at the very least, to be concerned with how the discipline might best contribute to the clarification of important issues associated with the announced theme of the Congress.

The United States and the United Kingdom contributed the two largest national blocs; Japan and most Western and Eastern European countries were well represented; and there were also delegations from India, and the Arab countries, as well as a scattering of participants from countries such as Argentina, Cuba, Pakistan, South Korea, Tanzania and Zaire. However, no delegates from China appeared, to the evident regret of Joseph Needham[1] who recalled, with some nostalgia, the consternation that had ensued at the IInd International Congress in London in 1931 when a well organized Soviet delegation led by Nikolai Bukharin had advanced a coherent set of Marxist interpretations of the history of science.[2]

Each of the eleven full-day symposia (one of which was organized by the International Congress for the History of Technology) featured sets of invited papers organized around a common topic. These formal symposia, and a large number of parallel, sub-disciplinary sessions, permitted approximately 400 contributed papers to be read, thereby offering more than enough to suit the tastes of almost any serious historian of science or technology, including even those with special interests in science and human values.

Symposium on Science and Human Values

The Science and Human Values symposium comprised the most explicit attempt to grapple with the theme of the Congress. Symposium speakers approached the topic from a variety of perspectives, and seemed to agree only that Western science, at least as construed in the context of Western rationalism, had failed to provide --

and probably could not provide -- an adequate framework in which to explore problems of human values.

In a lengthy and moving introduction, Joseph Needham offered some personal thoughts on the roots of the recent "movement opposed not only to the high technology born from modern science but also to modern science itself."[3] He expressed his opposition to any moratorium on research because of his abiding disinclination to believe that "any knowledge can be evil in itself," but he coupled that sentiment to a strong conviction that consistent strategies would have to be devised to regulate research applications. To Needham, the ethics and logic underlying the traditional sciences of China may provide substantial assistance in attacking the social problems created by the advance of contemporary science. He characterized Chinese ethics as profoundly humanistic and "devoid of all supernatural sanctions," and pointed out that absence of any codification of syllogistic logic among the Chinese philosophers had no doubt contributed substantially to the methodologies with which they studied nature.

Needham ended his introduction by reiterating his thesis that modern science differs from all previous scientific systems in not being culture-bound. For that reason he finds it more accurate to use the term "ecumenical" science rather than "Western" science. An important item on the research agenda of historians of science, he suggested, should be to identify more clearly the non-European elements in ecumenical modern science.

Shigeru Nakayama's[4] paper entitled "Alternative Sciences of the East" challenged Needham's implicit epistemological assumption that all scientific traditions must necessarily converge towards ecumenical science, citing as cases in point three classical Chinese and Japanese disciplinary traditions that differed profoundly from their Western counterparts. Chinese astronomy accepted irregular and non-conformist phenomena such as comets and novas as crucial to an understanding of nature, in contrast to the West's singular preoccupation with regularities. Eastern anatomists were concerned with spiritual harmonies rather than with mechanical functions. Mathematics in Japan was pursued and valued for entertainment rather than for any profound insights to which such a pursuit might lead.

Jerome Ravetz's[5] paper, "Science as a Cultural Symbol," traced the symbolic aspects of science from the early, missionary pronouncements of Bacon, Descartes and Galileo, through the high tide of Victorian optimism and into "the defensive and disillusioned positions of leading twentieth-century philosophers" such as Popper, Lakatos and Kuhn which, Ravetz claims, anticipated the "anti-science movement." He also maintained that although contemporary philosophers of science have largely abandoned science as a means for attaining "the good and the true" or "knowledge without sin," a substantial majority of influential modern scientists still retain the optimism of Descartes and Galileo. That optimism is, in Ravetz's view, peculiarly "totalitarian" in its tendency to annihilate other approaches to a comprehension of nature and in its intolerance of any suggestion that scientific arguments may be insufficient in any and all instances where scientists claim that they are sufficient. Thus, for example, in the Victorian age, science belittled religion; in modern times science is intolerant of suggestions of public participation and control.

R.R. Rashed's[6] paper entitled "La Notion de 'Science Occidentale'" implicitly supported a part of Needham's ecumenical science thesis by using the example of Arabic algebra to demonstrate the naivete of the view that modern science can be regarded largely as a logical and necessary extension of Western classical traditions. He traced the roots of that view to the 18th century when "Western science" and "experimental philosophy" were frequently contrasted with "Oriental wisdom" in the debate between modernity and traditionalism. Thus the terms "Occident" and "Orient" assumed historical as well as geographical meaning. By claiming that modern science was the direct, lineal descendant of Greek natural philosophy, the 19th century German historians were able to use the development of modern science in Europe as evidence of the innate cultural superiority of the West. Thus the term "Western science" assumed anthropological connotations as well. In Rashed's view, it was also used to annihilate non-European views of nature.

Jean-Jacques Salomon[7], in his paper on "Crise de la Science, Crise de la Société," provided the symposium's most sweeping and analytical critique. While agreeing that the crisis in both modern science and modern civilization is in large measure a crisis of Western rationalism, he argued that rationalism itself could not be discarded. Rather, the fault could be traced to the reduction of rationalism to "objectivism." Salomon believes that the failure of rationalism accounts for much of the current fascination with alternative sciences of the East. But he confessed to doubts about Needham's contention that China could -- or even wanted to -- develop modern science and technology according to its classical ethos.

Salomon contended that the dream of a golden age in which pure science was completely divorced from its ultimate applications, and thus innocent of political power, is a myth with the same degree of authenticity as the myth of the noble savage. Galileo's profound contribution was to make "thinking a mechanical operation," so that scientific truth could be arrived at through action rather than through contemplation alone. Thus the birth of modern science required that knowledge lose a "sense of its own purpose." To be sure the values asserted and maintained by science did not (and do not) completely overlap with the values asserted by political authority, and hence there have been (and will continue to be) conflicts between science and power. Nevertheless, the roots of an alliance are implicit in the writings of Galileo, Descartes and Bacon. As science has fulfilled its promise of providing the means toward power, the nature of the controversy between science and authority has shifted from a controversy over the nature of truth to a controversy about the efficacy of science. Science has yielded considerable ground to authority by absorbing an efficacy ethic, and in so doing has become increasingly successful. But as a result it has become increasingly unable to offer insights into humanistic problems. In Salomon's view the rationalism underlying modern science, reduced to "objectivism", has overthrown humanistic values, but has failed to replace them.

Miscellaneous Observations

Although value issues were addressed most extensively in the session just described, concern with the topic was also readily apparent in a number of other symposia: in the program on "Human Implications of Twentieth Century Communications Technology"; in papers contributed to the sessions on "Technology and Engineering

since 1600"; and in symposia devoted primarily to professional concerns. Brigitte Schroeder-Gudehus[8], for example, in the symposium on "International Cooperation and Diffusion in Science," argued that that topic required a consideration of the effects on scientific cooperation of conflicting systems of political values. Then, too, Charles Weiner[9] urged, in a symposium on Problems of Source Materials in the History of Science, that archivists must attempt to determine the types of questions people in the year 2000 are likely to ask about science and society in the 1970's, and to use those judgments as a basis for deciding what contemporary documents should be collected and preserved.

Not surprisingly, the Edinburgh Congress demonstrated that historians of science and technology, like the practitioners of other disciplines, have yet to agree whether the study of values is a legitimate disciplinary pursuit, and, if so, how the methodologies of the discipline should best be applied to such studies. But even though the Congress showed few signs of having been organized around its stated theme, it is perhaps significant that the Organizing Committee felt that the announced theme should be Human Implications of Scientific Advance. It remains to be seen whether the Organizing Committee for the XVIth Congress in Bucharest in 1981 will select a theme at all. But it is virtually certain that the Congress will also provide a diversity of perspectives on problems of science and human values as seen by historians of science and technology.

NOTES

1. Master, Gonville and Caius College, Cambridge University.

2. The papers presented by the Soviet delegates to the 1931 Congress have been reprinted, with a new forward by Needham, in a volume entitled Science at the Crossroads, London: Frank Cass and Co., Ltd., 1971.

3. All quotations, with the exception of those attributed to J.J. Salomon, are taken from the published abstracts of the respective papers.

4. History Department, University of Tokyo.

5. Philosophy Department, University of Leeds.

6. Institut d'Histoire des Sciences, Universite de Paris I.

7. The quotations attributed to Salomon are taken from a longer version of his Edinburgh paper presented at a 31 May-2 June conference in Brussels on "Crisis of Science in the European Societies?"

8. Institut d'Histoire et de Sociopolitiques des Sciences, University of Montreal.

9. Technology Studies Program, Massachusetts Institute of Technology, Cambridge, Massachusetts.

B. Commentary on the XVth International Congress of the History of Science

by Dorothy Nelkin
Cornell University
Ithaca, New York 14850

I focused my attention at the fifteenth International Congress of the History of Science on the activities of the International Council for Science Policy Studies. This Council, composed of thirty-nine members from seventeen countries, meets annually to exchange information about recent trends in science policy. The formal activities of the Council have included conferences, a summer school in science policy studies, and a recent book, (Science, Technology and Society -- edited by Ina Spiegel-Rosing and Derek DeSolla Price). The Council is creating opportunities to maintain broad contacts in a field that very much calls for an informed international perspective.

At the History of Science Congress, the Council organized a full day session on a provocative topic: Social Revolution and Science, a theme with great potential for an interesting and coherent program. The idea was to look historically and cross-culturally at the influence of revolution and political change on the development of science; and in this context, papers were presented on science in France during the First Republic, in Germany just after World War II, in Poland from 1900-1915, in Tanzania after independence, and in contemporary India and China. There were also papers on the attitudes towards science in the United States after the turbulence of the 1960's, and on the influence of social assumptions on the development of state medicine.

Such a program could have made a significant contribution to studies of the relationship between social change and the development of science. A number of the themes touched upon in individual papers could have been systematically and provocatively developed and compared -- for example, the tension between centralized and decentralized policy planning for science, the efforts to direct science toward national goals following periods of social upheaval, the problems of external control that emerge as science is directed towards social goals, conflicts of interest with respect to science in societies with rapidly changing values, and the effect of socio-political models on cognitive assumptions. There is by no means consensus on the relationship between scientific development and its socio-political context, so that such themes were potentially a basis for vigorous argument. Somehow, however, the issues that emerged briefly in individual papers were not thoroughly pursued and the anticipated arguments failed to develop. Some speakers chose simply to describe the institutional framework for science in their national context without drawing the relationship between social and scientific factors, while others were content to pursue well-trodden themes without the needed critical analysis.

This criticism is not meant to undermine the value of many of the papers, and I do not mean to suggest that the difficulties described were unique to this particular conference. Lack of thematic coherence, variation in quality, and absence of sufficient time for detailed discussion are problems familiar to all

meeting-goers. However, if international meetings are to be more than an opportunity for corridor talk, if they are to be the setting for the full and lively exchange of ideas, a number of steps must be considered: establishment and adherence to stringent review procedures; advance distribution of completed texts or abstracts; allottment of adequate time for discussion following presentations.

Despite its problems, the Congress provided a valuable opportunity for making new contacts and reestablishing old ones, and for comparing notes with colleagues from far-off places. The University of Edinburgh, strategically located between Marks and Spencer, and Greyfriar's Pub, provided a delightful and congenial setting.

C. Commentary on the XVth International Congress of the History of Science

by Daniel Kevles
California Institute of Technology
Pasadena, California 91125

(Editor's note: Because of space limitations we are unable to include the entire text of Professor Kevles' commentary on the Edinburgh meeting. An extract follows.)

My principal concerns at the conference were two sessions on Biological and Medical Science since 1600. Coming to the history of biology and medicine after many years in the history of physics, I was struck by the degree of similarity in the newer approaches being taken in both fields, especially by the growing emphasis on the social history of science. I found similar emphasis in other sessions I attended, including the history of physics, science and human values, science policy studies, science and society since 1600, and the relations between theories of heredity and of evolution. I was also struck by the extent to which scholars now exploring the social history of science are interested in the history of scientific ideas as such. A notable example of that combination at the conference was B. Norton's paper on R.A. Fisher, in which Norton argued that a commitment to eugenics brought Fisher to his synthesis of biometry and Mendelism. My reading of the conference may have been distorted, since I, of course, took a sample skewed by my own intellectual predilections. Nevertheless, despite the scheduling problems, the limitations on formal discussion, the smorgasbord quality of the offerings, certain patterns seemed evident: the history of science is in a state of upheaval, especially among British and American scholars. The social history of science is rapidly becoming a major part of the discipline. And, since a number of people, many of them younger scholars, are rejecting the distinction between the "internal" and "external" history of science as unwarranted and counterproductive, the upheaval shows signs of leading to a new understanding of man's attempts to comprehend and master nature.

IV. SOCIOBIOLOGY: THE NEW SYNTHESIS?

By Gerald Holton
Jefferson Physical Laboratory
Harvard University
Cambridge, MA 02138

From the Special to the General Discipline

The invitation to share some thoughts on sociobiology has turned out to be a temptation too difficult to resist, despite all reservations. While I must base my remarks largely on a reading of the accessible literature -- primarily E. O. Wilson's writings and commentaries on them -- the obvious dangers for anyone who is not an active researcher in biology are decreased on an occasion such as this symposium, where there has been an opportunity to check one's preliminary conclusions with a diverse group of scholars in biological fields.

I shall be addressing three related questions: What are the aims and claims of contemporary sociobiology? How does the enterprise fit into the history of ideas? And does sociobiology have the earmarks of being indeed the beginning of a major synthesis?

First, one must make a distinction. There are really two pursuits, both referred to by the same term, sociobiology, (defined as "the systematic study of the biological basis of all social behavior"[1]) and often indiscriminately merged in all discussions. One of the two pursuits is what I would call the Special (or Restricted) Discipline; the other, the General Discipline.[2] The former deals with animals below man. In Wilson's book Sociobiology: The New Synthesis, he devotes about 90 percent of the text pages and all but a handful of the approximately 2,500 references to research papers to the Special Discipline. And there seems to be little doubt that, in the sense of the Special Discipline, sociobiology "works" for large areas of animals exhibiting social behavior, from slime molds and corals to non-human primates. Thus, many specific observable and measurable aspects of behavior are correlated with genetic factors. To be sure, as in any growing scientific field, there are vigorous debates about detailed observations and conclusions, e.g., to what extent the relative investment in the care of offsprings is influenced by the degree of genetic relatedness of individuals in the Order Hymenoptera (wasps, ants, and bees)[3]. But the Special Discipline promises to mature soon into a Special Theory that may explain much of the observable social behavior of animals below man. This by itself is no mean promise, not least because of the large number (an estimated 10,000) and staggering biological diversity of social species that exist on this planet. We might then have the ability to use one coherent corpus of variables and one quantitative theory to predict aspects of the social

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behavior of non-human animals from a knowledge of population parameters (demographic information concerning population growth and age structure) combined with information on the behavioral constraints imposed by the genetic constitution of the species. Such an achievement would surely be counted among the major advances of science, even if not a single word of it would apply to the case of man. (One may add that if such a discontinuity in the application to man were discovered in principle, that discovery in turn would constitute a major mystery for science.)

While the Special Discipline attracts by far the largest investment of energy of researchers in the field of sociobiology, the major focus of attention from those outside the field is the General Discipline, which extends the promise and the program one crucial step further -- to man. But it is then this inclusion of human sociobiology that has transformed into a challenge what otherwise might have continued to be regarded as a specialty with limited interest. The challenge is signalled immediately in the subtitle of Wilson's book: "The New Synthesis," and in explicit statements such as these:

> For the present [sociobiology] focuses on animal societies, their population structure, castes, and communication, together with all of the physiology underlying the social adaptations. But the discipline is also concerned with the social behavior of early man and the adaptive features of organization in the most primitive contemporary human societies.[4]

The extension to modern man is immediately indicated to be only a matter of time:

> It may not be too much to say that sociology and the other social sciences, as well as the humanities, are the last branches of biology waiting to be included in the Modern Synthesis [neo-Darwinist evolutionary theory]. One of the functions of sociobiology, then, is to reformulate the foundations of the social sciences in a way that draws these subjects into the Modern Synthesis.[5]

Wilson does not claim that all this is already happening. Although it may be plausible to expect continuity across neighboring species on the basis of specific findings in disciplines such as physiology, psychology, genetics and demography, the general program is only sketched, and its supporting data for human sociobiology are relatively few (largely in the realm of "non-rational" behavior, e.g., incest taboo, infanticide, hypergamy, mental retardation and schizophrenia, and the biochemical basis of some behavioral mutations). But the driving force comes not only from such data; it comes also from an old dream:

> The dream has been to bring biology -- as a science, not simply as a source of unconnected facts -- into conjunction with psychology, anthropology, and sociology and to make it part of the foundation of the social sciences. That goal may now be at last feasible, if not actually in sight...It is hoped that knowledge of the subject will assist in identifying the origin and meaning of human values, from which all ethical pronouncements and much of political practice flow.[6]

From time to time Wilson is careful to ask for patience. He points out near the beginning of his book that "the formulation of a theory of sociobiology constitutes, in my opinion, one of the great manageable problems of biology for the next twenty or thirty years"[7], and he ends the book with the estimate that it may take as long as one hundred years[8]. These cautionary words are all too easily lost sight of because of the emphasis given to the basic program of identifying and using the postulate of continuities across species -- for example, that "the individual organism is only [the genes'] vehicle, part of an elaborate device to preserve and spread them with the least possible biochemical perturbation;"[9] that "in order to explain ethics and ethical ~~philosophers" one must~~ understand the role of natural selection in evolution, such as the connection between kinship and altruistic behavior; that "the hypothalamic-limbic complex of a highly social species, such as man, 'knows', or more precisely...has been programmed to perform as if it knows, that its underlying genes will be proliferated maximally only if it orchestrates behavioral responses that bring into play an efficient mixture of personal survival, reproduction, and altruism;"[10] or again "In this macroscopic view the humanities and social sciences shrink to specialized branches of biology; history, biography, and fiction are the research protocols of human ethology; and anthropology and sociology together constitute the sociobiology of a single primate species."[11]

To name only fields to which Wilson himself refers: the General Discipline is to lead to a synthesis, across all social species from colonial bacteria to man, of evolutionary biology, genetics, biochemistry and ethology, and specifically for man, also of anthropology, psychology, sociology, the humanities, and ethics. One is led to expect a mutual accommodation of conceptions such as bonding, sex, division of labor, communication, territoriality, patriotism, warfare, learning, aggression, fear, altruism, and the structure of DNA. Indeed, what has been left out of this projected synthesis makes a very short list -- chiefly the notions of the transcendental and of (undetermined) free will. This will turn out to be of more than passing significance.

It may not be inappropriate to inject here a personal opinion. Regardless of the success this program may ultimately have, I find it admirable for four reasons. (i) Science needs more such wide-ranging, intellectually "risky" efforts to balance our usual fare of small additions to the sandheap of individual analytical results. Sociobiology is attempting to become a "theory of principle" (a theory covering a wide domain in which a large variety of verifiable results are obtained deductively from a few secured postulates) rather than a phenomenological theory (the more common type of theory characterized by narrow domain, many ad hoc explanations via plausible inductions, with short chains between the observations and the conceptual material). (ii) Even if it fails eventually (as all systems do), the challenge which sociobiology is throwing down before the neighboring disciplines can have a strong, perhaps transforming effect on some of them -- although not necessarily along the lines envisaged by its proponents. And that is one way in which progress is traditionally made. (iii) Wilson's Sociobiology and related writings by the proponents may be viewed as significant cultural artifacts in their own right, because they represent a world view characterizing this part of the twentieth century -- for example, in their plea for a sophisticated form of flexible, almost stochastic predeterminism and materialism; in their apparently dispassionate concern with a secularized ethic; in their accent on rationality and their under-emphasis on affect and symbolic forms. In short, with all their

limitations they exemplify what is widely considered to be some of the best thinking today. (iv) Last but not least, the discussion of sociobiology among biologists and other scholars can and should present opportunities for the difficult and all-too-often neglected task of exploring the possible impacts scientific work may have on ethics and human values.

Notes on Outraged Sensibilities

The opportunity for such assessments has only begun to be taken seriously. So far, the scene has been dominated by expressions of outraged sensibility -- more often than not on the part of non-biologists -- triggered but not fully explainable by the type of statements on sociobiology made by its protagonists. These responses themselves are well worth studying as events in the history of science. This is not the place for such a study, but it would be useful to identify at least in a general way some reasons for the sense of discomfort produced in some quarters by the very discussion of sociobiology -- a reaction so strong that it has occasionally verged on becoming a case of "limitation of scientific inquiry." For as the New Scientist put it, "There is no doubt that many people have steered clear of the issue for fear of being labeled either as neo-Nazi or an hysterical radical."[12]

Opposition to sociobiology is of two forms. One is the understandable controversy within the specialty field that must test the claims of new proposals. A more visible opposition, ranging in intensity from polite disapproval to organized disruptions of meetings, focuses chiefly on the General rather than the Special Discipline; usually they do not claim to disprove data or conclusions as in the normal process of theory validation -- no doubt in part because of the early state of sociobiology. At bottom, the more vehement objections seem to have one or more of three separable but not independent bases:

(i) It would be wrong to deny that scientists and scholars, like other mortals, can be influenced by their "gut reactions." A good fraction of the reactions I have heard myself show this component. If the program of sociobiology at its most ambitious were to work, it is argued, it threatens "to short-circuit the person in the egg-egg cycle"; once more the progress of science would "objectivize the subjective" and "rationalize at the cost of affect and passion." We would then have a "clockwork model of man" as the "triumph of reductionistic scientism," bisecting man's nature. In a replay of 17th-century separation of primary and secondary qualities, we would be "casting away the qualitative, the ambiguous, the complex, and the artistic," in short much of what "makes each person unique with respect to any other person, and that which makes mankind unique with respect to other species." When Time magazine recently published a long and on the whole rather balanced "cover story" on sociobiology, it chose to put on the cover, as a kind of emotional shorthand, a picture of two puppets representing a young man and a young woman, looking helplessly and vacantly past each other as they dangled on their strings with the frozen gesture of an abortive embrace.[13]

Nor is Wilson insensitive to the dangers. In the final section of his book, he speaks of the purposes to which evolutionary sociobiology might be put in the future:

> If the decision is taken to mold cultures to fit the requirements of the ecological steady state, some behaviors can be altered experientially without emotional damage or loss in creativity. Others cannot. Uncertainty in this matter means that Skinner's dream of a culture predesigned for happiness will surely have to wait for the new neurobiology. A genetically accurate and hence completely fair code of ethics must also wait.
>
> The second contribution of evolutionary sociobiology will be to monitor the genetic basis of social behavior...If the planned society -- the creation of which seems inevitable in the coming century -- were to deliberately steer its members past those stresses and conflicts that once gave the destructive phenotypes their Darwinian edge, the other phenotypes might dwindle with them. In this, the ultimate genetic sense, social control would rob man of his humanity...[14]

(ii) Expressions of this sort, by the critics and by Wilson himself, reveal a rather widespread fear of abuse. By themselves, fears do not form a rational basis for deciding where sociobiology will be heading, not to speak of whether the inquiry should be limited even if it could be. But even if not rational, they can be reasonable extrapolations of ominous present trends. One of mankind's oldest preoccupations is the pursuit of vice and folly; in our time, advances of science and technology have been eagerly incorporated into that project. More evidence piles up day after day -- the insanity of heaping higher the mountain of ever more fiendish weapon systems, the behavior-control "experiments" of secret police on both sides of the ocean, the callous discharge into the environment of harmful by-products of industrial processes, and so forth. If greed and sadism have managed to benefit from the labors of scientific workers, it is reasonable to fear that other widely diffused human tendencies such as xenophobia, racism and the like could fashion themselves some protective "scientific" cloak. One remembers the abuse of "Social Darwinism" in such fields as economics, immigration policy, and eugenics in Edwardian Britain and elsewhere -- not to conjure up its deadly perversion by the Nazis with the full cooperation of German doctors, scientists, lawyers, and administrators. The sheer instinct of self-preservation may be sufficient to account for the fact that people are suspicious as never before about any new scientific theory or technological development that might enlarge the potential for the control of human behavior -- by whom? according to whose values? for whose benefit and at whose risk? with what institutional constraint?

The loudest protests I have heard leveled against sociobiology do not claim that any of the feared abuses have already occurred. So far, no specific proposal for basing social policies on current sociobiological knowledge has surfaced. The fears tend to refer only by analogy to what may have happened in related fields. To be sure, it is a new and difficult calculus: some modern victims of the perversion of science and technology are all too easily identified; other are not. (How would one prove to have been personally harmed by an escalation in the balance of terror? Or by feeling more and more like those puppets on the strings?) In this circumstance, sentiment can make itself felt -- and over the past few years sentiment has been shifting as it did in the handling of food additives. The Food and Drug Administration used to label most of them simply as GRAS (generally regarded as safe), but now additives are considered guilty until having been proved innocent. Similarly, in many quarters, those aspects of science and technology that

have health- or behavior-affecting potential are no longer GRAS, from recombinant DNA research to nuclear engineering. Limits of scientific inquiry is the new phrase that characterizes the whole movement. The skepticism about near dangers is no longer tranquilized by the promise of more distant rewards -- even by the promise of exposing, in the long run, those earlier biological and social adaptations that once may have been functional but which now are disastrous for mankind.[15] It would have been improbable that any form of sociobiology applicable to human beings, coming on the scene in this part of the century, would have been exempt from consequences of the current strain of pessimism.

(iii) Yet another "reasonable" and expectable type of adverse response to sociobiology may be identified as territoriality and dichotomization. A number of intellectuals in fields neighboring on sociobiology are concerned about what they perceive to be grand imperialistic designs on their area, and they are not calmed by the casual disclaimer that the success of the program may be a hundred years off.

Comments I have heard made by academics under this heading have contained such accusations as: that sociobiology "trivializes" the work of social scientists by "disaggregation", and shifts the "battlefield" to an entirely inappropriate area; that the ontogeny of human behavior must continue to be based first of all in the analysis of childhood experiences; that the whole enterprise is implausible because one cannot imagine the chain of "intermediate causal steps" necessary for understanding how heritability expresses itself operationally in behavior.

Wilson himself was not entirely unprepared for the professional resistance. When he announced that such fields as ethology and comparative psychology "are destined to be cannibalized" because the future cannot rest with their "ad hoc terminology, crude models, and curve fitting," he added "I hope not too many scholars in ethology and psychology will be offended by this vision."[16] In his more recent writings Wilson has done little to calm colleagues in neighboring territories. On the contrary, his essay "Biology and the Social Sciences" contains a direct attack on the separation between fields having adjacent levels of organization.[17] Going far beyond the so-called Modern Synthesis of Mendelian genetics and biochemistry, he envisages a "juncture" of neurobiology and sociobiology with social science. He focuses on the creative tension between neighboring fields whose relationship makes them act as "anti-disciplines":

> By today's standards, a broad scholar can be described as one who is a student of three subjects: his discipline, the lower anti-discipline, and the subject to which his specialty stands as anti-discipline [at the next level of organization]. A well-rounded neurophysiologist, for example, is deeply involved in the microstructure and behavior of single cells; but he also understands the molecular basis of electrical and chemical transmission, and he hopes to explain enough of neuron systems to help account for the more elementary patterns of animal behavior.[18]

In the evolution of molecular biology, "progress over a large part of biology was fueled by a competition among the various attitudes and themata derived from biology and chemistry -- the discipline and its anti-discipline."[19] Wilson feels that a similar process will eventually occur for sociobiology as the biologist glimpses the "reverse side of the social sciences"; for example, economics will be under-

stood from so general a perspective that the conventional treatment of the subject becomes merely "the description of economic behavior in one mammalian species with a limited range of the biological state variables,"[20] rather than the actions of man in the market place.

It is not surprising to find assertions of territorial claims in the replies to Wilson by members of other disciplines. But neither these assertions nor suspicions about the validity of the new methodology with its high ambition reveal the passions involved. Between sociobiologists and their opponents there is also evidence of a clash of fundamentally differing world views -- a kind of "n-culture" problem. Most intellectuals find it difficult to hold and juxtapose in their minds two still-developing systems with overlapping jurisdictions, the more so if the systems are based on incommensurate assumptions. This difficulty produces the cultural equivalent of a cognitive clash between sociobiology and the other approaches to understanding human behavior (as in humanistic psychology, where ambiguity, complexity, and confusion are handled quite differently). In this clash, the solution is all too often found in dichotomization, in the tendency to exclude all but one system instead of attempting to hold two or more systems in parallel.

Some Precursors

Just as the opponents of sociobiology can cite plausible motivations for their pessimism, the proponents have their own case for optimism. To deepen our understanding of the aims and claims, the powers and limits of contemporary sociobiology, we must now ask how the enterprise fits into the history of ideas. The whole field of research and the motivating spirit behind sociobiology are not the product of the last decade or two, as a citation analysis might lead one to believe. On the contrary, it is part of a long evolutionary development. Sociobiology too has its phylogeny, and was already well-established in the middle of the 19th century; at the time when the mechanists and vitalists were doing battle.[21] In 1845, a group of young physiologists, among them Helmholtz and Dubois-Reymond, swore an oath to account for all bodily processes in physical-chemical terms. They did not prohibit all metaphysical discussions of that science, but merely declared, in Dubois-Reymond's famous phrase, "ignorabimus," i.e., that we shall never know the great world riddles, except those portions that reveal themselves within mechanistic science.

This group was distinguishable from a parallel but more extreme group of experimental biologists and medical materialists who may be called the "nothing-but" school. To them, all things were to be reduced to a homogeneous mechanistic scheme, including the world riddles despaired of by the others. This naturally led them to attack the established order, the alliance between church and state, and all the other impedimenta to radical progress in science and without. Not surprisingly, many of them were socialists and visionary fighters for social justice.[22] From the present perspective, the medical materialists and the Helmholtz group were far closer to each other than to any of their common enemies; they were, for example, united in being anti-transcendentalists.

To me, the most interesting figure among all these was the biologist, Ernst Haeckel.[23] A fiery materialist and socialist, he scoffed at all myth-mongers and offered a complete world view based on evolution and monism (unity of mind and

matter) that would solve all puzzles. The turbulent book he wrote in 1899, toward the end of his career but at the height of his fame, was in fact titled simply The Riddle of the Universe [Die Welträthsel]. It swept over Europe like a crusade against mystification, against what he regarded as "the untruth foisted on the people by their spiritual and economic masters." Science was to triumph over theology by spreading the gospel of evolution infused with a modicum of pan-psychism. Haeckel's chief point was that there was a unity of the inorganic and the organic world, grounded in the laws of conservation of matter and energy (what he called "the law of substance").

It was indeed a replay, complete in many details, of an ancient message. Here it is first in the words of Lucretius, introducing the world view of the earliest Greek atomist:

> I will essay to discourse to you of the most high system of heaven and the gods, and will open up the first-beginnings of things, out of which nature gives birth to all things and increase and nourishment...Nothing is ever gotten out of nothing by divine power, Fear in sooth takes such a hold of all mortals because they see many operations go on in earth and heaven, the causes of which they can in no way understand, believing them therefore to be done by divine power. For these reasons, when we shall have seen that nothing can be produced from nothing, we shall then more correctly ascertain that which we are pursuing, both the elements out of which everything can be produced and the manner in which all things are done without the hands of the gods.[24]

In Haeckel's own battle against such notions as personal immortality, the conventional belief in a creating God, or in the belief in a mind or a purpose behind evolution, he did not have to refer explicitly to Lucretius. Haeckel's sentences had their own grand, teutonic sweep:

> All the particular advances of physics and chemistry yield in theoretical importance to the discovery of the great law which brings them to one common focus, the law of substance. This fundamental cosmic law establishes the eternal persistence of matter and force, the unvarying constancy throughout the entire universe. It has become the pole-star that guides our monistic philosophy through the mighty labyrinth to a solution of the world-problem.[25]

The promise of eternal persistence and of a guiding pole-star was vivid in the sweeping and reassuring chapters in Haeckel's book: "The History of our Species," "The Phylogeny of the Soul," "Consciousness," "Immortality," "The Evolution of the World," "The Unity of Nature," "Our Monistic Ethics," and, finally, "The Solution of the World-Problems." In comparison, Wilson's book is an exercise in understatement and scientific objectivity. I doubt that it is able to arouse a small fraction of the hopes and fears that Haeckel's book did for about half a century.

Another precursor of Wilson is Jacques Loeb, the author of The Mechanistic Conception of Life (1912). Born in 1859, he was a scientist in the old style of philosopher and social innovator, certain that scientific findings might lead

directly to political and social-development consequences. Influenced by Schopenhauer (as were so many others of his generation), he seems to have turned to biology in order to find evidence against the conception of the freedom of the will. Perhaps his best work was on animal tropism, the involuntary movements imposed by such environmental conditions as light upon organisms; he considered it a model for understanding behavior in terms that avoid the use of the noxious conception of "will." The accomplishment for which he is most famous, artificial parthenogenesis by physical-chemical means, fell in the same category of scientific research findings with anti-transcendental and anti-metaphysical implications.

From 1911 on, cheered by the proof of the existence of molecules by Jean Perrin and others as the triumph of mechanistic philosophy, he spoke and wrote on "the mechanistic conception of life," and published his book of that title in 1912. In it, as Donald Fleming observed, Loeb reduced life to a physical-chemical phenomenon, free will to an illusion generated by tropistic causes, and religious faith to an absurdity. He proclaimed the total validity of mechanistic principles, and derived from them a system of human ethics based on instincts whose unobstructed expression would rejuvenate world society. In his book, Loeb asked whether man's "inner life" -- the "wishes and hopes, efforts and struggles," should be "amenable to a physical-chemical analysis".[26] And he answered yes, even if the proof would have to come from much research that still waited to be done: "For some of these instincts the chemical basis is at least sufficiently indicated to arouse the hope that the analysis, from the mechanistic point of view, is only a question of time".[27]

In the last pages of this work, just as in Haeckel's and in Wilson's, Loeb has a section entitled "Ethics." Here is a passage:

> We eat, drink, and reproduce not because mankind has reached an agreement that this is desirable, but because, machine-like, we are compelled to do so. We are active, because we are compelled to be so by processes in our central nervous system...The mother loves and cares for her children, not because metaphysicians had the idea that this was desirable, but because the instinct of taking care of the young is inherited just as distinctly as the morphological characters of the female body...Not only is the mechanistic conception of life compatible with ethics: it seems the only conception of life which can lead to an understanding of the source of ethics.[28]

In comparison, Wilson's is a soberer, more scientifically grounded effort. Ironically, partly for this reason, it will not have the same popularity that these predecessors had.

Evaluating the Potential for Synthesis

Against this background we can now evaluate the inherent claim of sociobiology that it produces the New Synthesis (or <u>any</u> synthesis). What, indeed, is the <u>structure</u> of a synthesis, and how does sociobiology correspond to it?

I view synthesis and analysis as methodological themata, synthesis being one component of the thematic pair, the other being analysis.[29] The term synthesis of course brings to mind certain methodological practices in the works of philosophers

since Plato. But it is necessary to distinguish between four general meanings of the term: (1) synthesis used in the reconstitutional sense (e.g., where an analysis followed by a synthesis re-establishes the original condition); (2) synthesis used in the transformational sense (e.g., where the application of analysis and synthesis advances one to a qualitatively new level, whether in a given specialty field such as biology or in two specialty fields such as biology and sociology; (3) synthesis used in the judgmental sense (as in the Kantian categories and their modern critiques), and (4) synthesis used in the general, cultural sense.

To specify the properties of a synthesis in operational terms, we select a body of work that is, beyond challenge, a historic synthesis, and use it both to identify the structure of a working synthesis in science as well as to measure how close sociobiology may be to the model. The Newtonian synthesis (the historic unification of celestial and terrestrial physics) is probably the most distinguished example; while referring to it to compare the half-dozen major structural elements of any synthesis, we shall keep in mind that we thereby calibrate, so to speak, the top reading on that kind of thermometer.

(1) Historic Roots

Almost by definition, a synthesis has roots in the history of the fields within which it produces coherence. For the Newtonian synthesis, one of these roots reaches back to the grand scheme of Thales of Miletus, the other to Pythagoras of Crotona. The former was essentially positivistic and materialistic, with a certain resemblance to modern empiricism, while the latter was metaphysical and formalistic. It is significant that each of these systems, which came into western culture at about the same time, 2500 years ago, were impelled by the persisting drive to find basic unity underlying the diversity of all experience, but nevertheless were diametrically opposite in assumption and appeared mutually exclusive in content.

From each of these two schools, a separate chain of distinguished followers emerged over the next centuries. Aristotle stands at a pivotal position in the history of thought in part because he was the first major thinker who was not a follower of only one of the two main trends, but who made a powerful attempt to adapt elements from both of the antithetical systems in a new synthesis. Nothing even faintly analogous was done successfully in natural philosophy until the joining by Kepler and Galileo of neo-Platonic and materialistic conceptions. Newton's synthesis, then, was the last grand bridging of the materialistic-positivistic tradition and the formalistic-metaphysical tradition in natural philosophy. Later attempts were restricted to narrowly delimited fields within the physical sciences. Thus Faraday's central theme, in his research on relations between gravity and electricity, was what he called "the long standing persuasion that all the forces of nature are mutually dependent, having one origin, or rather being different manifestations of one fundamental power." To this day, this is the Holy Grail of theoretical physicists, who try to find one force to explain the gravitational, the electromagnetic, the weak and the strong interactions.

Turning to sociobiology, it too has a distinguished phylogeny; it is in fact the current terminal point on a trajectory or proliferation of system builders issuing primarily from the materialistic-mechanistic and anti-metaphysical school of Thales of Miletus and his followers -- Anaximander, Anaximenes, Heraclitus, Leucippus, Democritus, Anaxagoras and Lucretius. The more recent successors

developed from the trajectory of these physiologues, teaching "disenchanted" or "positive" explanations of nature's phenomena, are some aspects of Newton, Vico, Laplace, D'Alembert and Condorcet, Comte, Darwin, Helmholtz, Dubois-Reymond, Herbert Spencer, T.H. Huxley, Haeckel, Loeb, Mach, Julian Huxley, Haldane, the early Lysenko, and Schrödinger (in "What is Life?").

If we look beyond their many differences, they all share fundamental ambitions, approaches, and themata. For example, the matrix of social values and the moral base are taken not as a priori but as susceptible of explanation within a materialistic world view. These natural philosophers tend to opt for continuity instead of uniqueness, for unity rather than discreteness. In modern sociobiology, the old thema of classical physical causality persists, although modified and recast in terms of tendencies and "potentials" -- an even older yet still current thema. Many of the moderns are social innovators, and opt for an essentially optimistic and liberal political stance.

Thus looking at this aspect of syntheses in general -- synthesis as the climactic achievement of a long-term trajectory -- the ambition of sociobiology is entirely recognizable.

(ii) Inclusion and exclusion of elements

The raw materials from which a synthesis must be fashioned are individual, seemingly disparate elements or separate classes of entities. Thus the Newtonian laws govern the motions of objects from atomic to galactic size. Yet, Newton also specifically excluded large sets of elements from his synthesis -- not only "occult qualities" that were no longer desired, but also light and its propagation, chemical reactions, much of fluid mechanics and the theory of elasticity, sensations in the human body, and the properties of the ether.

Sociobiology seems to be in danger of not knowing how to exclude explicitly some tempting candidate-elements. One has the impression that the range of behaviors, traits, and details clamoring for inclusion is enormously large. To be sure, history reminds us that exclusion very frequently is not, and perhaps cannot be, an a priori conscious decision, but can only come at the end of a long series of unsuccessful attempts at inclusion. That is, exclusions are the result of the discovery of "impotency principles." And to find those, one needs time.

(iii) A First Principle

After Newton, nothing so basic as the intuition of a universal law of gravitation furnishing the first principle on which to build a system will perhaps ever be granted to another synthesist. But sociobiology does make several basic, fundamental postulates -- for example, the central theorem that animals behave so as to optimize their inclusive fitness; that there is some molecular basis of behavior (i.e., that the genes "program the potentials"); that for all phenotypes, including behavior, there is selection by interaction of genes and environment; that there is a continuity of mammalian traits in humans. For the theory's eventual success in the large sense, it would seem necessary to postulate explicitly the smallest number of independent statements, and insofar as possible to exhibit the role of parsimony and necessity among those postulates that do remain. (I am

of course aware that some biologists may well object to this criterion, trained as they are to be more tolerant and respectful of complexity than are physicists.)

We also know from the study of earlier scientific advances that the formulation of powerful "first principles" often had to wait for the formulation of new concepts (energy, valence, invariance, quantization, complementarity). New terms, new metaphors, a new language parallel new generalizations. They can of course not be identified in advance of the pressure for fruitful hypothesis; nevertheless, one might speculate on the type of additional concepts that a general theory of sociobiology may require.

An example would be one conception to handle the simultaneous actions of opposites: potentiation and determination -- something like a flexibly constraining developmental field that contains decision vertices having probabilistic parameters. Perhaps new terms are also needed for those distinctive and preferably quantifiable human traits (if any) that are not shared with other species (e.g., similar to the distinction between roles in human societies vs. castes in social insects). Terms such as altruism, slavery, and warfare, when applied to non-human species, may turn out to have exhausted their usefulness and might now be recast, to avoid unnecessary limitations or at least the charge of undue anthropomorphic connotation.[30]

(iv) Cohesion of a General System

Again, since Newton (with the possible exception of General Relativity) no system with such general coherence, no such deductive testable schema based on one or a few principles can be expected to arise again in our time -- least of all in a theory which is still under construction before our very eyes. It will be a long time before we see the equivalent of the deduction (and hence "explanation") of Kepler's empirical laws. Yet there are beginnings in sociobiology, such as efforts to understand the mating system, the size of families and colonies, and diffusion speeds. More such advances, and a good cataloging of them, will be needed to make this synthesis widely persuasive. The current literature shows that this is the growing edge of the whole effort.

I recognize that workers in other sciences may be understandably depressed (or overly impressed) by the success under this heading which the 300-year effort of modern physics has had at its culmination, for that is the model which physics willy-nilly puts before the other sciences. The power of the deductive network produced in physics has been illustrated in a delightful article by Victor F. Weisskopf[31]. He starts by taking the magnitudes of six physical constants known by measurement: the mass of the proton, the mass and electric charge of the electron, the light velocity, Newton's gravitational constant, and the quantum of action of Planck. He adds three or four fundamental laws (e.g., de Broglie's relations connecting particle momentum and particle energy with the wavelength and frequency, and the Pauli exclusion principle), and shows that one can then derive a host of different, apparently quite unconnected, facts that happen to be known to us separately by observation: for example, the size and energies of nuclei, the mass and hardness of solids such as rocks, the height of mountains on earth, and the size of our sun and of similar stars. This is indeed fulfilling Newton's program, triumphantly. However, one must not superimpose the same expectation on the

program of Lucretius and the related one of Wilson.

(v) Demystification and Central "Image"

It is well known that Newton had a profound philosophical impact on his contemporaries by his demonstration that quite "ordinary" and causal chains were at work in producing complex or frightening effects (tides or comets, respectively), that the world of infinite change was explainable by the persistence of a very few simple laws which any schoolchild could memorize. By extending the reign of familiar terrestrial processes and showing them to operate throughout the knowable world, a single, almost hypnotic image could suggest itself, that of the universe as a majestic clockwork. Its visualizability at one mental "glance" was probably a powerful factor in its popular acceptance.

Sociobiology in its current version does hold out a similar promise of "explaining" complex or disturbing effects in the processes of human society, from homosexuality to warfare. Even if there should be only a quite partial delivery on that promise, the effects upon the world view of our society will be enormous. Sociobiology does seem to lack, however, a central image, analogous to the vision of a clockwork conjured up by the Newtonian synthesis. There is not even a complex one such as Darwin's "tangled bank." The voluminous and painstaking work chronicled in Wilson's book and similar sources may never lend itself to such a feat of fruitful oversimplification.

(vi) Prediction

Predictive capability, as in deducing correctly the return of a comet from Newton's laws, is usually regarded as the ultimate test of how "scientific" a synthesis is -- the "harder" the science, the prouder and the more confident it is. In this respect, sociobiology seems to be in only an early stage of development. However, we may be touching here on the long debate concerning essential differences between the biological and the physical sciences, rather than on a sine qua non of scientific synthesis as such. For at the very least, a far greater degree of complexity is built into biological systems by virtue of the necessary connection of each function with the organism's history on the one hand and with its environment on the other.

(vii) Cultural Reach

The claim of the Newtonian synthesis as a powerful exemplar of a cultural synthesis that changed civilization has been amply documented. (If one were allowed only a single example, an analysis of the role of Newtonian philosophy in Thomas Jefferson's draft of the American Declaration of Independence might suffice.)

By this measure, of course, the strategy with respect to sociobiology is, once more, patience. It does appear that both the proponents and the more vociferous and politically oriented opponents of sociobiology are united in the expectation that the New Synthesis of which Wilson speaks will be one that changes our culture. If it does not, the synthesis will still be one in the "transformational" sense.

* * * * *

One may conclude that on many, perhaps most, counts sociobiology has a fair chance eventually to bear out its promise, provided that more of the crucial elements are supplied in the on-going research, notably with respect to cohesion and prediction, and thereby advance from the Special Discipline to the General Theory. It can only be guessed how widely the New Synthesis will be welcomed by the adjacent disciplines. Nor can we predict whether the ideas of sociobiology will be as severely abused as were, on occasion, Darwin's and Einstein's -- although one positive outcome of the sobering experience of the recent past for all scientists should be their greater watchfulness and, where necessary, activism to expose abuses forcefully as soon as they are actually identifiable.

The issue of scientific validity will of course be decided in the laboratories and in field research. If experimental evidence in favor of human sociobiology does turn out to be voluminous, varied, and positive, the fathers of the field will no doubt be installed in the Pantheon. But it is a curious question whether Haeckel and Loeb and the others who will be waiting for them there will in fact approve of this new version of the ancient quest. No doubt they will like to hear evidence that the social behavior of animals can generally be linked, across all species, to the mechanism of natural selection. They will also be pleased that biology, anthropology and many neighboring fields will have been shaken up in a fruitful way. But we can imagine they will at least raise an eyebrow that in our time the offsprings of Lucretius no longer found theological opponents to engage head-on, and addressed themselves instead to the modern equivalent of the ancient seat of moral force, i.e., to the social sciences.

In answer, the new arrivals will have to plead that the road to the New Jerusalem once more proved to be more difficult than had at first appeared, and that it may be quite enough if we end up wiser about the behavior of people and other animals. Even in making a synthesis, there is a large and useful middle ground between complete success and failure.

NOTES

1. Edward O. Wilson, Sociobiology: The New Synthesis (Cambridge, Massachusetts: Harvard University Press, 1975), p. 595.

2. As Wilson and others have pointed out, it is too early to apply the word Theory.

3. Compare, for example, R.L. Trivers and H. Hare, "Haplodiploidy and the Evolution of the Social Insects," Science 191, No. 4224, (1976): 249-263; and R.D. Alexander and P.W. Sherman, "Local Mate Competition and Parental Investment in Social Insects," Science 196, No. 4289 (1977): 494-500.

4. Wilson, op. cit., p. 4.

5. Ibid.

6. Ibid., pp. 11 and 22.

7. Ibid., p. 5.

8. Ibid.

9. Ibid., p. 3.

10. Ibid., p. 4.

11. Ibid., p. 547.

12. R. Lewin, "The Course of a Controversy," The New Scientist (13 May 1976): 344-345. A petition condemning research in sociobiology was presented by a group to the Council of the American Sociological Association at its meeting of September 1977. There is, of course, also a large and growing literature of informative critiques and assessments; the most recent work at hand are papers by R.D. Alexander, R.C. Lewontin, S.A. Kauffman, and M. Ruse, in F. Suppe and P.D. Asquith (eds.), PSA 1976, Vol. II: Symposia (East Lansing, Michigan: Philosophy of Science Association, 1977).

13. Time magazine, 1 August 1977.

14. Wilson, op. cit. Wilson adds at the end: "When we have progressed enough to explain ourselves in these mechanistic terms, and the social sciences come to full flower, the result might be hard to accept. It seems appropriate therefore to close this book as it began, with the foreboding insight of Albert Camus: 'A world that can be explained even with bad reasons is a familiar world. But, on the other hand, in a universe divested of illusions and lights, man feels an alien, a stranger. His exile is without remedy since he is deprived of the memory of a lost home or the hope of a promised land.' This, unfortunately, is true. But we still have another hundred years."

15. Wilson (op. cit., pp. 24-25) writes: "For example, the tendency to expand at the expense of territorial neighbors might well be in human genes, having been advantageous to our ancestors through evolutionary time, but it would lead to global suicide now. To rear as many healthy children as possible has been the road to security in many cultures and periods of history, but with the world's population brimming over, it is now the way to environmental disaster. To an increasing degree we are forced to make moral decisions that directly influence the future of the human species. Soon we may have to pick and choose among the emotional guides that we have inherited, and determine those that should be followed and those that should be sublimated or redirected so that our behavioral patterns will both conform with biological principles and foster the growth of the human spirit."

16. Wilson, op. cit., p. 6.

17. E.O. Wilson, "Biology and the Social Sciences," Daedalus, 106, No. 4 (1977): 127-140.

18. Ibid., p. 128.

19. Ibid., p. 129.

20. Ibid., p. 136.

21. Of the many accounts, I refer to the excellent, brief one by Donald Fleming in his introduction to the re-issue of Jacque Loeb's The Mechanistic Conception of Life (Cambridge, Massachusetts: Harvard University Press, 1964). Also see Everett Mendelsohn, "Revolution and Reduction," in Y. Elkana (ed.), The Interaction Between Science and Philosophy (Atlantic Highlands, New Jersey: Academic Press, 1974), pp. 407-420.

22. For example, Rudolf Virchow, one of the sympathizers, supported the German Revolution of 1848 and became the chief of the liberal opposition to Bismarck. See also Frederick Gregory, "Scientific versus Dialectical Materialism: A Clash of Idealogies in Nineteenth-Century German Radicalism," Isis 68, No. 242 (1977): 206-223.

23. Haeckel was one of the major influences in bringing Darwinism to Germany. Long after his death, this Darwinism was twisted in an effort to lend respectability to programs of euthanasia and genocide.

24. Lucretius, The Nature of the Universe, Book I, 25. (Chicago, Illinois: Henry Regnery Co. for the Great Books Foundation, 1969), pp. 2-5.

25. Ernst Haeckel, The Riddle of the Universe (London: Watts and Co., 1929; originally Bonn, 1899).

26. Loeb, op. cit., p. 28.

27. Ibid., p. 32.

28. Ibid., p. 33.

29. I have discussed these conceptions at greater length in G. Holton, "Analysis and Synthesis as Methodological Themata," Methodology and Science (Netherlands), Vol. 10, No. 1 (Spring 1977): 3-33; also in G. Holton, The Scientific Imagination: Case Studies (New York: Cambridge University Press, 1978, in press), Chapter 4.

30. On this point, see the interesting essay, largely supportive of sociobiology, by Donald T. Campbell, "On the Conflicts between Biological and Social Evolution and between Psychology and Moral Tradition," American Psychologist, 30, No. 12 (December 1975): 1103-1126.

31. Victor Weisskopf, "Of Atoms, Mountains, and Stars: A Study in Qualitative Physics," Science, 187 (1975): 605-612.

V. ADDITIONS TO GENERAL BIBLIOGRAPHY

American Society for Engineering Education (ASEE). 1977 Engineering College Research and Graduate Study. Washington, D.C.: American Society for Engineering Education, 1977.

This directory compiles information on the expenditures for over 18,000 research projects in college engineering programs in the U.S., Puerto Rico, and Canada. Detailed descriptions of the programs include information on graduate student appointments, stipends and participation. [Copies are available from Publications Sales, ASEE, Suite 400, One Dupont Circle, Washington, D.C. 20036; $7.00; $3.50 for students with identification of school and program.]

Ashby, Lord, and Mary Anderson. "Studies in the Politics of Environmental Protection: The Historical Roots of the British Clean Air Act, 1956: II. The Appeal to Public Opinion over Domestic Smoke." Interdisciplinary Science Reviews 2, March 1977: 9-26.

"A succession of severe fogs, coupled with the publication of mortality rates which turned out to be as severe as those caused by cholera, stimulated the creation of a smoke abatement lobby. This essay describes the work of that lobby and the ..effort...to put a smoke-abatement Bill through parliament" (9). Article shows the interaction of public opinion, pamphlet publication and other communication, and legislative action.

Basiuk, Victor. Technology, World Politics, and American Policy. New York: Columbia University Press, 1977.

Analysis of present and projected state of technology and consequent effect on national and international policy.

Begab, Michael J., and Stephen A. Richardson, eds. The Mentally Retarded and Society: A Social Science Perspective. Baltimore, Maryland: University Park Press, 1975.

Proceedings of a 1974 conference, containing a wide selection of articles on larger social context of mental retardation, its effects on society and vice versa, as well as on the particular problems of individuals (communication difficulties, education, even discussion of juvenile delinquency.)

Bereano, Philip L. Technology as a Social and Political Phenomenon. New York: John Wiley and Sons, 1976.

Book of readings on the general and theoretic aspects of the interaction between technology and society. Many of the well-known articles on this subject are included in the collection.

Blissett, Marlan, ed. Environmental Impact Assessment. Lyndon B. Johnson School of Public Affairs, The University of Texas at Austin: Engineering Foundation, 1976.

In an attempt to examine environmental impact statements as aspects of policy

implementation, this collection of articles provides a variety of analyses of the implementation of the National Environmental Policy Act of 1969. Sections on the techniques for index development or data analysis and on public participation in administrative hearings highlight this book.

Callahan, Daniel. "On Defining a 'Natural Death' - An Ideal for Public Policy." Hastings Center Report 7, June 1977: 32-37.

Aims at a definition of "natural death" which will be "at once rationally persuasive, emotionally satisfying, socially advantageous, and politically attractive;" then considers the implications of the definition for the individual and for society.

Cantore, Enrico. Scientific Man: The Humanistic Significance of Science. Forest Grove, Oregon: International Scholarly Book Services, Inc., 1977.

Intent of this book is "to clarify the principles for integrating the spirit of science into an authentic humanism," as well as analyze many of the contemporary misinterpretations of science by both scientists and humanists.

Carter, Luther. "Nuclear Wastes: Popular Antipathy Narrows Search for Disposal Sites." Science 197, 23 September 1977: 1265-1266.

Citizen opposition in a growing number of locales is hampering the government's efforts to find sites for the permanent disposal of nuclear wastes.

Carter, Luther J. "Public Interest Lawyers: Carter Brings Them into the Establishment." Science 196, 27 May 1977: 961-964.

Analysis of the Carter Administration's choice of personnel at the subcabinet level. Impact of the appointments on government and on public interest law.

Clasquin, F.F., and Jackson B. Cohen. "Prices of Physics and Chemistry Journals." Science 197, 29 July 1977: 432-438.

"The high cost of journals has forced some scientific libraries to reduce drastically or eliminate entirely the purchase of books in order to maintain journal and other serial subscriptions" (432). Analysis of survey of problems in Physics and Chemistry, but extendable to other fields. Some suggested remedies.

Engelhardt, H. Tristram, Jr., and Daniel Callahan. Knowledge, Value and Belief. Hastings-on-Hudson, New York: The Hastings Center, 1977

This book continues the Hastings Center exploration of the relation of ethics to science, focusing particularly on theology and the foundation of ethics. Essays range from Paul Ramsey on Kant's moral theology to Stephen Toulmin on "Doctor's Ethics and Biomedical Science."

Fadiman, Clifton. "A Technological Culture." The Center Magazine 10, March/April 1977: 71-78.

Fadiman's thirty theses on the definition, limits, and implication of technology.

Fowler, William A. "Physics in 1976 - a personal account." Physics Today 30, April 1977: 33-41.

Reflections of the President of the American Physical Society on the public image of the physicist, including some fascinating examples of how famous physicists have put on a "public face" for the media. If physicists are to widen their areas of activity in society, Fowler says, then they must project a more realistic image of what they are -- "capable, practical, ingenious, innovative, and at the same time human beings like our neighbors" (41).

Frontiers of Science. Washington, D.C.: National Science Foundation, 1977; $4.00, Government Printing Office stock number 038-000-00314-3.

Articles from past issues of the NSF's Mosaic magazine.

Glantz, Leonard H. "Massachusetts Supreme Judicial Court Reverses Conviction of Dr. Kenneth Edelin." Medicolegal News 5, Winter 1977: 3-4.

Brief analysis of the issues and of the Court's opinion in the case.

Golub, Robert, and Joe Townsend. "Malthus, Multinationals and the Club of Rome." Social Studies of Science 7, May 1977: 201-222.

The authors argue that "the imperatives of the multinational firm and the international economy require a change in the world's political organization and that such a change is implicit in an acceptance of the [Limits to Growth] analysis." Emphasizing the stresses which have arisen between the multinational corporations and the national governments, as well as the changing attitudes of the underdeveloped countries, Golub and Townsend describe the Limits debate as part of an effort to shape public opinion toward the feeling "that we are faced with obscure 'physical forces' rather than the political and economic results of earlier historical development."

Goodchild, Peter. "Screening 'Marie Curie.'" New Scientist, 18 August 1977: 418-420.

The producer of the BBC documentary drama series on Madame Curie discusses the difficulties of interpreting a scientific biography with both sufficient dramatic impact and historical accuracy.

Gordon, Donald. "Herbert Marcuse: Aspirations and Utopia." Futures 9, April 1977: 147-151.

Marcuse as a technological utopian.

Gordon, James. "Space-Time Rag." The Sciences 17, July/August 1977: 20-21.

Tongue-in-cheek confession by a science writer that "I just don't understand physics;" rather he values the sense and aura of the science. "I value physics not for how well it explains the world, but, much as the irreligious loved the Latin mass, for the way it sounds " (20).

Grobstein, Clifford. "The Recombinant-DNA Debate." Scientific American 237, July 1977: 22-33.

Examination of the science and policy involved in the debate. Includes review of the proposed guidelines or other plans for containment or monitoring of Recombinant DNA research.

Harwood, Jonathan. "The Race-Intelligence Controversy: A Sociological Approach; I -- Professional Factors." Social Studies of Science, Vol. 6 (1976): 369-394. "The Race-Intelligence Controversy: A Sociological Approach: II -- 'External Factors.'" Social Studies of Science, Vol. 7 (1977): 1-30.

The thesis of Part I is that scientists' disciplinary allegiances predispose them to adopt particular positions on the race-intelligence issue. In Part II it is argued that committment to either a hereditarian or an environmentalist position in this controversy is to be explained in terms of a scientist's world view.

Hawkes, Nigel. "Science in Europe/The Antinuclear Movement Takes Hold." Science 197, 16 September 1977: 1167-1169.

Popular protest against nuclear power has reached formidable proportions in several European countries. This article reviews the antinuclear movements in France and Germany.

"I'm Madly in Love with Electricity -- and Other Comments about Their Work by Women in Science and Engineering." Published by the Lawrence Hall of Science (attn.: Careers, University of California, Berkeley, California 94720.)

Booklet written to introduce women to careers in science; includes some lists of societies and other publications. Single copies available free; each additional copy; $1.00.

Impact of Science on Society, 27 July/September 1977.

Issue devoted to "Science and Latin America."

Jacob, Francois. "Evolution and Tinkering." Science 196, 10 June 1977: 1161-1166.

"...[N]atural selection does not work as an engineer works. It works like a tinkerer...who uses everything at his disposal to produce some kind of workable object" (1163). Jacob builds a delicate and enlightening analogy, describing examples at the molecular level or in the human brain.

Jordan, Don. "The Town Dilemma: Discharging a Duty." Environment 19, March 1977: 6-15.

Description of the recent conflict over disposal of PCB-contaminated industrial wastes in the landfills and streams of Monroe County, Indiana. Towns dilemma: what to do about the waste? What about the victims? Outline of the emerging conflict between local, state, and federal authority, science, industry, environmental groups, and the rights of the individual.

Leeper, E.M. "Scientists Ask Congress to Control DNA Research." BioScience 27, February 1977: 141-143.

News review of December 1976 Congressional Seminar on Recombinant DNA research controls, co-sponsored by SIPI and the U.S. House Environmental Study Conference.

Leeper, E.M. "Trumbull Testifies on Public Participation." BioScience 27, June 1977: 387-389.

Account of testimony at oversight hearings on Recombinant DNA, Science, Research, and Technology Subcommittee of the House Committee on Science and Technology. Panel included AIBS Executive Director Richard Trumbull, Dorothy Nelkin, Alan McGowan, Jeremy Stone, and Norman Wengart.

Lepkowski, Wilbert C. "Frank Press Outlines Science Advisor Role." Chemical and Engineering News 55, 16 May 1977: 19-22.

News report on how the new Presidential Science Advisor likes his job.

Lowrance, William W. "The NAS Surveys of Fundamental Research 1962-1974, In Retrospect." Science 197, 23 September 1977: 1254-1260.

A review of the origin, design, conduct, policy impact and usefulness of the ten surveys of the health and direction of major fields of science that were conducted from 1962 through 1974 by committees under the aegis of the National Academy of Sciences' Committee on Science and Public Policy (COSPUP).

Lubrano, Linda L. Soviet Sociology of Science. Columbus, Ohio: American Association for the Advancement of Slavic Studies, 1976.

History and analysis of Naukovedenie in the Soviet Union. Lubrano's discussion of the social and political context of research and theories is especially useful for those interested in the sociology of science.

Luria, Salvador E. "The Goals of Science." The Bulletin of the Atomic Scientists 33, May 1977: 28-33.

In a version of a talk delivered to the American Academy of Arts and Sciences, Luria concentrates on "the cost-benefit reckoning of the fruits of research, the decision-making process in the selection of research programs, and the distrust of science and scientists" manifest in society (29). Luria also points out that criticism of Recombinant DNA research falls into three categories: mystical, sanitary, and political.

Macklin, Ruth. "Consent, Coercion, and Conflicts of Rights." Perspectives in Biology and Medicine 20, Spring 1977: 360-370.

Concentrates on the "cluster of moral issues" surrounding the case of Jehovah's Witnesses who refuse blood transfusions for religious reasons.

May, William F. Notes On the Ethics of Doctors and Lawyers. Bloomington, Indiana: The Poynter Center, May 1977.

In an incisive discussion of the quandries facing professionals in law and medicine, Professor May guides the reader through complex issues of philosophy and ethics and points the way toward application to all professions. Sections on the enduring purposes of a profession, on the connections of the professional to client, colleague, market place and institutional host, and on the role of the professional as teacher and citizen highlight this essay and may have particular relevance to science.

McCaull, Julian. "Research in a Box: Escape of New Life Forms." Environment 19, April 1977: 31-37.

News report on December 1977 Seminar on Recombinant DNA research, co-sponsored by SIPI (Environment's publisher).

Mitroff, Ian I., "Some Unresolved Issues in the Psychology of Science -- A Research Agenda." 4S Newsletter 2, Summer 1977: 20-22.

The author briefly outlines seven areas he feels are deserving of more research -- e.g., "the symbolic and/or affective images that scientists form of themselves, their work, their colleagues, students, objects of study."

Mohr, Hans. Lectures on Structure and Significance of Science. New York and Berlin: Springer-Verlag, 1977.

Based on series of lectures delivered in 1975 on the nature of scientific thought and the nature and significance of the scientific enterprise. In particular, Mohr's chapters on "Science and Responsibility," "The Motivation of Science," and "Science and Values" contain interesting syntheses of current thinking and research in these areas.

Morgan, Robert P., and Eric R. Hartman, eds. Proceedings of the Conference on University Education for Technology and Public Policy. St. Louis, Missouri: Washington University 1977. (Available from the Department of Technology and Human Affairs, Box 1106, Washington University, St. Louis, Missouri 63130.)

This 150-page volume records the edited papers and discussions of the December 1976 Conference. Specific emphasis was on courses, degree programs and research in university education for technology and public policy. The Proceedings includes papers or remarks by representatives from many of the programs in the STS field.

Murray, Chris. "Environmentalists Fight for Delaney Clause." Chemical and Engineering News 55, 23 May 1977: 16.

News report on the conflict between cancer and politics -- the saccharin issue.

National Science Foundation. Annual Report for 1976. Washington, D.C.: U.S. Government Printing Office, 1977.

This report of the NSF in 1976 includes a statement by Director Richard C. Atkinson and reviews of NSF accomplishments in the past year.

National Science Foundation. Expenditures for Scientific Activities at Universities and Colleges, Fiscal Year 1975. (Copies of the report, NSF 77-307, are available from the U.S. Government Printing Office, Washington, D.C. 20402. Stock number is 038-000-00-316-0. Call GPO at (202)-783-3238 to request price.)

This report from the National Science Foundation provides data on Federal and other support for separately budgeted R & D spending, expenditures for instruction and departmental research, and capital spending for scientific activities. R & D expenditures at academic institutions increased 12% in 1975, an increase due largely to increased Federal support of R & D.

National Science Foundation. Graduate Science Education Student Support and Postdoctorals, Fall 1975. (Copies of the report, NSF 77-313, are available from the U.S. Government Printing Office, Washington, D.C. 20402, at $2.20 per copy. Stock number is 038-000-00-33-0.)

A National Science Foundation annual report on patterns of graduate enrollment and postdoctoral support in science and engineering fields, compiled from data supplied by graduate science departments in Ph.D.-granting institutions. Findings note that graduate science and engineering enrollments may have reached a standstill after a slight rise over the last two years; but number of women enrolled in science programs is increasing.

National Science Foundation. Manpower Resources for Scientific Activities at Universities and Colleges, January 1976. (Copies of the report, NSF 77-308, are available from the U.S. Government Printing Office, Washington, D.C. 20402, at $2.00 per copy. Stock number is 038-000-00-320-8.)

Contains data on the employment of scientists and engineers at U.S. universities and colleges, based on a survey conducted in January 1976. Data are analyzed in terms of various characteristics, such as sex, type of activity, and type of institution.

National Science Foundation. National Patterns of R & D Resources: 1953-77. (Copies of the report are available from the U.S. Government Printing Office, Washington, D.C. 20402, at $1.50 per copy. Stock number is 038-000-00-324-1.)

Total R & D spending in the United States is estimated to reach $40.8 billion in 1977, 9% above the 1976 level; the Federal portion is also rising, to approximately $21.8 billion in 1977. These and other findings are included in the NSF report on funding patterns in the United States.

National Science Foundation. Projects in Higher Education: Science, Mathematics, Engineering. (Copies of the report are available from the U.S. Government Printing Office, Washington, D.C. 20402, at $3.20 per copy. Stock number is 038-000-00250-3.)

In science, mathematics, and engineering, many of the experimental projects in education have been supported by the National Science Foundation. Directors of projects from the "Alternatives in Higher Education" and "Science and Engineering Technician Education" programs of NSF have prepared brief descriptions of their activities in order to provide basic information about these NSF-supported

projects to other project directors, the academic and scientific communities, and the general public.

Nelkin, Dorothy. "Creation vs. Evolution: The Politics of Science Education," in E. Mendelsohn, P. Weingart, and R. Whitley (eds.), The Social Production of Scientific Knowledge, Sociology of the Sciences, 265-287. Dordrecht-Holland: D. Reidel Publ. Co., 1977.

As Nelkin points out, the challenge to science of the "scientific creationists" may be among the most complex and strange of recent history, since the creationists themselves may often be scientists who work "within the sociological framework of the contemporary scientific establishment." Nelkin analyzes the current situation and then turns to fallacies that are evident as scientists try "to transfer their professional expectations about science to the diffusion of scientific knowledge and to their quest for credibility in the public domain" (266).

Ocean Policy Committee of the Commission on International Relations NAS-NRC. "The Marine Scientific Research Issue in the Law of the Sea Negotiations." Science 197, 15 July 1977: 230-233.

Imposition of the 200-mile coastal limit greatly affects the progress of scientific research on the oceans and their inhabitants. The committee gives four examples of research recently endangered or hampered by refusals of states to allow research off-shore. Speaking for the oceanographic community, the committee spells out the essential objectives in any future treaty re research.

Pelizzoli, Luigi; Maria Christina Lombardini, and Alba Dini Martino. "Images from School: the Views of Italian Teachers and Pupils." Futures 9, April 1977: 160-168.

Two reports on study of future images (Italy in the year 2000) held by children and their teachers. Includes some illustrations from the children's drawings. Authors conclude that results show children thinking "in global terms, since thinking about the future means not only thinking about one's own future but also that of others" (166).

Recombinant DNA Research," Bulletin of the Atomic Scientists 33, May 1977: 10-27.

Balanced and informative review of issues in two local actions -- New York State and Cambridge, Massachusetts. Includes five separate articles: "A Legal Officer's Dilemma," New York State Attorney General's statement by Louis Lefkowitz; "An Imaginary Monster," by James D. Watson, who feels that "only danger we face is the specter of untested regulations;" "Guidelines That Do the Job," by Wallace P. Rowe; "Present Controls Are Just a Start," by Richard P. Novick, M.D.; and a reprint of the 5 January 1977 report of the Cambridge Experimentation Review Board.

"Recombinant DNA - A News Forum." Chemical and Engineering News 55, 30 May 1977: 26-42.

Includes three position papers (and rebuttals by all participants): "Potential Benefits Are Large, Protective Measures Make Risks Small," by Bernard D. Davis; "Uncertainties Great, Is the Gain Worth the Risk?" by Erwin Chargaff; "Public Must Regulate Recombinant Research," by Sheldon Krimsky.

"Recombinant DNA Hearing at Harvard." Boston University Journal XXIV, Fall 1976: 5-23.

Edited and expunged transcript of the 28 May 1976 hearing before the Harvard University Committee on Research Policy. An open letter to the President from Sens. Edward Kennedy and Jacob Javits is appended to the transcript.

Ritchie-Calder, Lord. "Science Is For All." The Center Magazine 10, March/April 1977: 2-12.

Asserts that Western domination of science is an accident of history; describes various proposals for the international sharing of scientific and technical knowledge and for the fostering of science education.

Saint, William S., and E. Walter Coward, Jr. "Agriculture and Behavioral Science: Emerging Orientations." Science 197, 19 August 1977: 733-737.

Description of shift in field "away from a conceptual perspective emphasizing communication to one in which technology and social organization are deemed essential in understanding and promoting agricultural development" (736).

Sanders, Howard J. "Supply and Demand for Chemists - Looking to 1985." Chemical and Engineering News 55, 4 July 1977: 18-30.

Comprehensive report on employment prospects in chemistry, based on Bureau of Labor Statistics projections; predicts some balance in the supply and demand.

Schurr, George. Science and Ethics. Manchester, England: SISCON, University of Manchester, 1977.

First American contribution to the SISCON series of trial-use texts. The book is divided into "sessions".-- one, on the internal ethics of science; two, the ethics of the basic relationship between science and society; and three, the "ethics entailed in the scientific manipulation of nature."

Science and Technology for Development: International Conflict and Cooperation. United Nations Conference on Science and Technology for Development, 1977.

A bibliography of studies and documents related to UNCSTED, available in U.S. from the Council on International and Public Affairs, 60 East 42nd Street, New York, New York 10017, $6.00.

Scientific Manpower Commission. Manpower Planning for Scientists and Engineers. Washington, D.C.: Scientific Manpower Commission, 1977: $2.00, available from AAAS.

This report of a Spring 1977 workshop presents the discussions among people, both in and out of government, who implement, regulate, or enforce federal mandates on the labor market for scientists and engineers.

Shapin, Steven, and Barry Barnes. "Science, Nature and Control: Interpreting Mechanics' Institutes." Social Studies of Science 7 (1977): 31-74.

This paper is based on the premise that the movement to found Mechanics' Institutes in Britain during the 1820's and 1830's was informed by an interest in the social control of sectors of the working classes. The author's objective is to show how the founders of the Institutes thought a scientific education would aid in the social control of those artisans who were their designated target.

Shapley, Willis, Don I. Phillips, and Herbert Roback. Research and Development in the Federal Budget, FY 1978. Washington, D.C.: AAAS, 1977.

This report is the second in a series prepared by the AAAS to contribute to the understanding and discussion of U.S. Federal R & D budgets and issues. In addition to discussion of what happened to the FY 1977 budget, Part I of the report examines the proposed (Ford) and amended (Carter) versions of the FY 1978 budget. Part II concentrates on the basis for R & D budget decisions and the role of Congress.

"Should the Delaney Clause Be Changed? - A News Forum." Chemical and Engineering News 55, 27 June 1977: 24-46.

Includes four position papers (and rebuttals): "U.S. Health Will Be Jeopardized If Delaney Clause Is Abandoned," by William Lijinsky; "Tolerance Levels Can Be Set for Chemical Carcinogens," by Frederick Coulston; "Delaney Clause Should Be Strengthened, Not Weakened," by Sidney M. Wolfe; "The Delaney Clause Must Be Amended and Modernized," by Rep. James G. Martin.

Sieghart, Paul. Privacy and Computers. London: Latimer New Dimensions Ltd., 1976.

Introduction to the subject for the person not an expert in this area; explores legal, social and political issues on an international scale.

Simring, Francine Robinson. "The Double Helix of Self-Interest." The Sciences 17, May/June 1977: 10-13, 27.

Indictment of the NIH advisory system -- "The coils of mutual obligation for grants and position have wound themselves around scientists, thus presenting barriers to impartial evaluation and honest criticism of scientific work" (10).

Smith, Merritt Roe. Harpers Ferry Armory and the New Technology: The Challenge of Change. Ithaca, New York: Cornell University Press, 1977.

History of the reception of a specific new technology -- the pace was perhaps slower than had been assumed. Impact of social, cultural, political situations on this acceptance.

Suppe, Frederick, and Peter D. Asquith. PSA 1976, Volume two. East Lansing, Michigan: Philosophy of Science Association, 1977.

Proceedings of the 1976 Biennial Meeting of the Philosophy of Science Association. Symposia papers include discussions of diverse topics such as the philosophy of medicine, complex systems, the philosophy of technology, sociobiology, and scientific realism.

Trumbull, Richard. "The Biologist Census." BioScience 27, March 1977: 192-195.

Report on the initial 2069 responses to a census of AIBS member-scientists; concentrates on employment and compensation data, tabulated by age and sex.

"User Survey Okays NSF Peer Review System." Chemical and Engineering News 55, 30 May 1977: 16-21.

News report on the results of survey, co-sponsored by U.S. House and the National Science Board, of NSF reviewers and applicants.

Vetter, Betty M. Supply and Demand for Scientists and Engineers - A Review of Selected Studies. Washington, D.C.: AAAS, 1977.

Assesses current participation of women in science and engineering.

Wade, Nicholas. "Death of the B-1: The Events Behind Carter's Decision." Science 197, 5 August 1977: 536-539.

Analysis of the political forces at work for and against production of the U.S. B-1 bomber, including the effect of grass-roots lobbying by the anti-B-1 coalition and the influence of well-timed media reports.

Wade, Nicholas. "Gene Splicing: Senate Bill Draws Charges of Lysenkoism." Science 197, 22 July 1977: 348-350.

Review of state of Senate bill establishing regulatory apparatus on Recombinant DNA research; also discussion of other currents of opinion on regulation, throughout the scientific community.

Wade, Nicholas. "Thomas S. Kuhn: Revolutionary Theorist of Science." Science 197, 8 July 1977: 143-145.

Review of a "landmark in intellectual history," its author, and its continuing impact and varying reception in the fields of history, philosophy and sociology of science.

Walsh, Efthalia. "The Handicapped and Science: Moving into the Mainstream." Science 196, 24 June 1977: 1424-1426.

Impact of implementation of the Rehabilitation Act of 1973 on science and science education. "Most students handicapped from an early age have been barred from

pursuing scientific careers, because, without an introduction to science vocabulary and to development of concepts and problem-solving in elementary school, the student is unable to continue to higher levels." How specifically to remedy this situation?

Walsh, John. "NSF Science Education: Basic Issues Still Unresolved." Science 197, 15 July 1977: 233-236.

Situation in the Science Education Directorate - history of the glories, trials, and tribulations. Shifts in personnel and management models are discussed.

Walters, LeRoy, ed. Bibliography of Bioethics, Volume Two. Detroit, Michigan: Gale Research Co., 1976.

Another in excellent series sponsored by the Center for Bioethics, Kennedy Institute, Georgetown University. Extensively cross-referenced and featuring both print and non-print items.

Walters, LeRoy. "Some Ethical Issues in Research Involving Human Subjects." Perspectives in Biology and Medicine 20, Winter 1977: 193-210.

With emphasis on biomedical research, the article analyzes several major ethical issues in human research in an attempt to identify "one or more ethical principles which are pertinent to each issue" -- moral justification, research design, risk-benefit analysis, selection of subjects, informed consent, social control, compensation of injured research subjects.

Weisskopf, Victor F. "The Frontiers and Limits of Science." American Scientist 65, July-August 1977: 405-411.

Science must have a nonscientific base, must necessarily be embedded "in a much wider realm of human experience." "This emotional and social embedding of science is the precondition of the quest for scientific truth." While the internal and external frontiers of science are largely defined by scientific knowledge, the limits of science are rooted in the social context.

Whiteside, Thomas. "Annals of Crime: Dead Souls in the Computer-I." The New Yorker 50, 22 August 1977: 35-65.

First of two-part series on computer crime; this article primarily details examples; good introduction for layperson.

Williams, Trevor. "Scientific Literature: Its Influence on Discovery and Progress." Interdisciplinary Science Reviews 2, June 1977: 165-172.

Historical summary of the development of published communications in the sciences -- the role of the scientific societies, growth of abstract journals, and review of the current changes such as increased use of IR systems, microform publishing, and the synopsis journals.

Winner, Langdon. Autonomous Technology: Technics-out-of-Control as a Theme in Political Thought. Cambridge, Massachusetts: M.I.T. Press, 1977.

On technological determinism and the relation of technology to current political thought.

Wolf, C.P. "Social Impact Assessment: The State of the Art Updated." Social Impact Assessment 20, August 1977: 3-19.

First of a two-part series on the field of "people impacts," interdisciplinary analysis of the social effects of policies, programs, or projects while they are still in the planning stage. Article includes a history of the development of SIA and a description of the formal and informal information networks presently operating in the field.

Woolcock, J.B. "Quis Custodiet Ipsos Custodes?" Perspectives in Biology and Medicine 20, Winter 1977: 246-259.

Criticism of current graduate training in the sciences -- it fails to encourage the probing of the ethos and the purpose of scientific endeavor. "During his graduate training the student's image of science changes...," but this evolutionary process is neither monitored nor guided in what the author considers the proper manner.